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TRANSMISSION AT 140,000 VOLTS.

It is with great pleasure that we are able to describe in the current issue a transmission system which marks another step forward in the utilization of high voltage for electric-power transmission. Transmission at 140,000 volts represents a long step forward, since it almost cuts in half the amount of copper required for transmission at the highest voltage previously attained. As our readers will remember, the maximum voltage utilized hung for very nearly a decade in the region around 50,000 or 60,000 volts. The number of plants operated at such voltage was steadily increasing, but the movement forward was temporarily checked. There was good reason for this, for at about the point mentioned the practical limit of insulation by means of pin-type insulators seems to have been reached. Such insulators, although they had been greatly improved over those used at lower pressures, became unwieldy and troublesome as attempts were made to adapt them to higher and higher voltages, and finally the time came when the danger limit was near. Considering the various contingencies of practical use, it has proved unsafe to operate transmission line insulators with a factor of safety below 2.5 or 3. Even at 50,000 volts working pressure this factor was impaired when the weather conditions were bad. It is doubtful whether any pin-type insulator yet manufactured can be trusted to stand up at 100,000 volts, under spray equivalent to what may be encountered in practice, with any degree of certainty. In most cases even the most carefully designed insulators will frequently spill over under test below this pressure. These conditions do not justify the use of working voltages much in excess of 60,000 volts, although this figure was now and then under fairly favorable circumstances exceeded. The great step forward was made with the advent of the suspension insulator, which itself has been steadily improved. By the use of such insulators the factor of safety could be increased to almost any extent necessary, and the immediate result of the introduction of this type was a jump forward in voltage to the vicinity of 100,000—a pressure quite adequate for most transmissions even of the kind which would now be classified as long-distance. The step forward to 110,000 volts was made on the Michigan system with which the plant here described is affiliated and was soon followed by others. Once the mechanical details of suspension insulation had been worked out, it was obviously only a question of a little time before the voltage would pass above the 100,000-volt mark to almost any point which economic considerations demanded.

The Au Sable transmission seemed to offer a favorable opportunity for another advance in voltage, although in point of fact the distance was in itself one which could comfortably be spanned without going to extremes; but modern practice tends more and more to the building up of

networks covering huge territory, and as these develop, increase of working pressure is a logical necessity even though the first linkages in the network may not absolutely require it. It was therefore determined to go forward and the great step was taken. The system went into operation about a month ago over the first 125 miles of a line ultimately to be 100 miles longer, and has been in entirely successful service since then.

The point of greatest interest, of course, is the line itself. It is carried on steel galvanized towers of the tripod construction of 40 ft., 50 ft. and 60 ft. on the lowest conductor, spaced about 500 ft. apart. Two conductors are carried on one side of the tower and one on the other, each supported by a string of 10-in. disk insulators occupying a vertical space of 5 ft. 3 in. The two conductors on the same side of the tower are 12 ft. apart vertically, while the other two sides of the triangle are 17 ft. 4 in. The conductors themselves are No. 0 equivalent, medium hard-drawn stranded copper, and under ordinary conditions seldom show coronal discharge even at the full working pressure of 140,000 volts. This pressure is pretty near to the critical coronal pressure, however, so that when operated, as it happens to be just at present, with a heavy rise in voltage due to the capacity reactance, the losses by discharge toward the receiving end of the line rise to a considerable magnitude. The charging power required is in the vicinity of 80 kva per mile, and when the receiving transformers are disconnected the open line carries about 3000 kw dissipated as coronal and leakage loss in one form or another as the voltage rises. Load at the receiving end may actually diminish the line current as the power-factor moves toward unity. With the load for which the transmission is designed, some 25,000 kw, the added inductance should pull the power-factor near to unity and keep the voltage down to a point where the coronal losses will become comparatively trivial. At the present time, with a heavy lagging load of 4000 kw at the end of the line, the power-factor at the generators has been found as high as 85 per cent, leading, so that a very heavy load is obviously necessary to pull down the power-factor to a reasonable point. It still remains a question whether, in view of heavy real coronal losses and the difficulties of regulation induced by the extremely high capacity reactance, so high a voltage as this is justifiable for the amount of energy delivered. With considerably larger conductors, corresponding to a very much greater load transmitted, this difficulty would be in part offset.

The interesting thing, however, is that the difficulties of operation do not depend on any question of insulation strength, since the line has actually performed as steadily and peacefully as if worked at much lower voltage, but rather upon the extreme magnitude of the reactance factors. It would seem that much remains to be done in the way of controlling these before the use of so high a voltage as 140,000 can be undertaken on a large scale. The difficulties are certainly not insuperable. They may be greatly reduced by judicious installation of inductive load at the substations along the line, by dropping the frequency, using the smoothest attainable wave-form and applying various other remedies which will promptly suggest themselves to the engineer.

CONSOLIDATION OF ENERGY SUPPLY SYSTEMS.

Although the paper presented by Mr. Samuel Insull before the American Institute of Electrical Engineers in New York on April 5 had the title "The Relation of Central-Station Generation to Railway Electrification," yet the discussion by the author covered a much broader field than this designation would indicate. In fact, it dealt with one of the most important subjects before the central-station owners and operators to-day, namely, the supply of electrical energy for all purposes throughout a given community from a single network of conductors. In its broader aspects the problem admits of only one solution. It has been demonstrated that financial advantages can be obtained by combining several adjacent small electricity supply stations into one central station, with larger and more efficient generating units costing less per kilowatt to install and less per kilowatt-hour to operate. It is especially economical to make such a physical consolidation in cases where the maximum loads on the separate smaller stations do not occur simultaneously, as is true to an appreciable extent with railway and lighting loads. Considered from the viewpoint of the community as a whole, obviously it is quite as advantageous for different companies owning separate generating stations to combine these stations into one as it would be if the stations were owned by one company and operated under one management. When existing conditions are such that the systems would be kept physically separate if owned in common, it needs no argument to show that the supply of energy to the several systems from one source would not prove advantageous.

Viewed broadly, the above considerations would seem to be controlling. However, in any specific case the determining feature is, and will always be, whether the owners of the proposed common generating system can furnish energy more cheaply than the prospective customer can generate energy for his own needs. The fact that energy can be produced in a common large station carrying diversified loads at a less cost than in a smaller station having loads of one general character is hardly effective as an argument to convince a person that he should buy energy from the common station at a greater cost than he can produce it for himself. With few exceptions, any well-managed electric-lighting station can afford to supply energy to the local street railways more cheaply than the railways can generate energy for their special use, but few indeed are the communities blessed with a central-station management far-sighted enough to obtain the railway load for its system unless the railway and lighting systems are owned in common. In any given case the matter turns around the question of rates. If the rates for energy are not such as to allow the central station to obtain the railway load advantageously to both itself and the railway, suspicion should rest first on the system of rate making and second on the management of the property. What would be economically advantageous if the property were owned by one company should prove advantageous to the several companies owning the different parts of the property. In the final analysis, practically every central station will find it advantageous to carry all electrical loads within its territory. The time has arrived when no central-station management can afford longer to ignore these fundamental economic relations.

NETWORKS OF ELECTRICAL CONDUCTORS.

Ever since incandescent lamps were first connected to street mains in cities, about thirty years ago, networks of conducting mains have necessarily existed. In large cities these conducting networks have great extent and complexity. They embody, in the aggregate, a large amount of capital, the interest and depreciation on which constitute a significant part of the cost of distributing the energy. The conducting networks are approximately maintained at constant potential throughout, under all conditions of load, by means of feeders welded into them at definitely selected but scattered locations, these feeders terminating in the switchboards of the supply stations. The general laws of the automatic distributions of current and pressure over a network are few in number and easily expressed, but the complexities of the actual conditions, in their numerous ramifications, are so great that it is extremely tedious to attempt numerical computation of these distributions.

In the first instalment appearing elsewhere of an article by Professor Crocker some of the salient principles that guide the engineer to a numerical solution of network electrical states are discussed. In the earliest days of electric networks in this country the first networks were actually modeled electrically on a map with german-silver mains and feeders of the proper dimensions to represent actual sizes of copper conductor, and with actual little resistance loads connected across the mains at the positions of the houses, in accordance with estimated future demand. The currents and pressure drops in the miniature system were then measured electrically. The next step was to canvass and estimate loads and mark them off on a large-scale map of the city. With the aid of a specially constructed machine, the gravitational centers of these loads were found on each set of mains and the sizes of the mains computed for each street with reference to the maximum permissible main drop of pressure. The feeders were also assigned with definite relation to the expected load of the first three years on the same scheme. Some half dozen different sizes of mains were standardized, and the nearest size to that called for by the computation was selected in each case.

Experience showed, however, that the growth of demand on the network soon obscured the original forecast and required the replacing of smaller by larger mains at considerable expense. A more or less haphazard method of planning networks resulted, aided by the rapid growth of American cities, of demand for electric service and of capital available for use in that service, with the result that precalculation or precise design of main conductors fell out of use. It is only a question of time, however, when, with the natural retardation of city growth incident to increased costs of living, and with greater stability in electrical supply, the economies of the situation will reassert the need for scientific engineering design in future extensions of city conducting networks. In Germany this condition has been more definitely crystallized, and German textbooks on conducting networks take the lead to-day. As is indicated in the article, the simplest way of conceiving the electrical conditions is to analyze the actual system of current distribution into two parts, namely, the no-load distribution and the load distribution. The former is due wholly to differences between the pressures applied to different points of the network, such as at feeding points or at opposite ends of mains, and the latter is due wholly to loads applied across the mains. Each of these two subsystems can advantageously be computed separately, and the algebraical sum of the two is then the complete solution.

THE EFFECT OF ULTRA-VIOLET LIGHT ON EYESIGHT.

The facts that light rich in rays of ultra-violet frequency may be harmful to human eyesight and that certain of the well-known artificial light sources produce ultra-violet rays have led to the assumption in certain quarters that many of the lamps developed for commercial use cause eye trouble. That much existing eye affection must be attributed to the use of artificial light cannot be denied, but the extent of the damage done by ultra-violet rays is more largely a matter of inventive imagination than demonstrated proof. Considerable eye strain can be attributed to the increased use of the eye under modern as compared with earlier conditions. Moreover, incorrect use of either natural light or artificial light of proper composition has caused enormously greater eye trouble than has the mere use of light of improper composition. Although oculists do not agree as to the exact damage occasioned by the lights of equal intensity but differing in spectral composition, yet if the rays in the violet and ultra-violet ranges can properly be considered proportionately more dangerous to eyesight than the rays in the central, red or infra-red portions of the spectrum, one can determine which of several light sources is most liable to cause eye trouble, and then group the sources in the order of their trouble-producing characteristics by ascertaining the relative intensities of the rays in the spectra of the lights from the sources.

A study of the above nature has been conducted to a successful conclusion by Dr. Louis Bell, as described by him in an article on page 807 of this issue. The author employed refined engineering methods in his spectrophotometric determinations. Having decomposed the light being studied, the ultra-violet portion of the spectrum was separated from the remainder by using a special glass that possessed the highly advantageous feature of being transparent for rays throughout the visible and infra-red portion of the spectrum but opaque for violet and ultra-violet rays. By means of a thermopile the ultra-violet radiations from various light sources were not only compared with each other, but were measured in terms of ergs per second per square centimeter at the thermopile. The result indicated that for equal density of illumination the high-temperature mercury-vapor lamp equipped with its standard absorbing globe emits the least, and the carbon arc lamp equipped with a quartz globe emits the most, ultra-violet radiation, with direct sunlight having an intermediate position, the relative values being 4.3, 16.1 and 91. In view of the fact that the density of illumination by sunlight is normally scores or even hundreds of times as great as that produced by any modern artificial light source, it is safe to assert that the danger to eyesight from ultra-violet light produced by commercial light sources has been greatly exaggerated.

SUPREME COURT REFUSES TO REOPEN DICK PATENT CASE.

The United States Supreme Court has declined to rehear the Dick patent case, adding no statement of reasons for its refusal.

Senator Norris Brown, of Nebraska, chairman of the Senate patent committee, stated that a meeting of his committee would be held on Friday of this week to consider legislation to amend the patent laws. Following the announcement of the refusal of the Supreme Court to reopen the Dick case, Senator Brown said he believed amendment of the patent laws is desirable to prevent the widespread monopoly now possible under the decision in the Dick case. This view is also held by Senator Shively, of Indiana, a Democratic member of the committee. It is stated that Senator Brown will introduce a bill prepared by Patent Commissioner Moore.

Representative William A. Oldfield, of Arkansas, chairman of the House committee on patents, stated that he is preparing legislation to meet the situation brought about by the Supreme Court decision. Representative Prouty, of Pennsylvania, has introduced a bill among the provisions of which are that patents shall be dated from six months after filing application, and that no owner can use his patent to fix or control the price at which the patented product can be sold, except that he shall have a right to fix the royalty to be paid for the right to use the patented machine, device or product.

COMMITTEE CONFERENCE ON SEATTLE CONVENTION.

A conference of chairmen and members of different committees directly engaged in the preparatory work for the convention of the National Electric Light Association at Seattle next June was held in Minneapolis on April 5, under the direction of President Gilchrist. All of the various subjects and the arrangements and exercises connected with the trip to Seattle and with the convention were taken up.

As practically all of the special trains will arrive in Seattle on Sunday, June 9, leaving June 10 free for registration, it was decided to have the annual baseball match on the afternoon of June 10. The usual reception and opening of the exhibition in the armory will take place in the evening. The transportation committee gave a full account of all of its work and the latest arrangements for the six special trains, some of which are already filled to from 60 to 70 per cent of their capacity. It is quite likely that one or two of these specials will have to be run in two sections.

Details of entertainment features provided along the route, as at Los Angeles, San Francisco, Portland, etc., were also discussed. In connection with the invitation from Portland, it was decided to take the tour de luxe trains from Seattle to Portland on June 14, so as to enable the delegates to see as much as possible of the rose festival and of the electrical parade, leaving June 15 free for the Portland trips and excursions, before embarking for Yellowstone Park in the evening. A special return trip from Seattle through Yellowstone Park has been arranged over the Northern Pacific Railroad, to accommodate those not on the special trains who may wish to visit this national park.

The local entertainment committee outlined the provisions made for the entertainment of the ladies on June 11, 12 and 13. The plans include an automobile excursion around the city of Seattle and its suburbs on June 11, a sail on Puget Sound June 12, and a visit to the Country Club and a golf tournament on June 13. No special plans will be made for the entertainment of the male members and delegates, outside of visits to power plants, etc., and excursions provided by the Seattle Electric Company to some of the more spectacular hydroelectric plants on June 14.

The exhibit committee reported that more than half of the space had already been taken and that negotiations were under way for the remainder. The committee also reported that, in addition to the decoration of the interior of the armory, the street from the armory to the new Washington Hotel would, in all probability, be illuminated. The hotel committee has already made a number of reservations and requested that those persons intending to go to the convention register as early as possible.

With regard to the program, President Gilchrist stated that it was intended to dispose of the business in about eight sessions, in order to take care of the thirty-six items, including papers, reports and special addresses. There will probably be three sessions on June 11, three on June 12 and two on June 13. It was arranged to have the Commercial Section again divide up its work into four sessions. At the meeting which will be held on the evening of June 12 the report of the public policy committee will be presented, and following it there will be an illustrated lecture on the electrification of the Panama Canal. The present plans are to invite the Chamber of Commerce and prominent citizens to the session on the evening of June 12 and to throw open the exhibit to the general public on the evening of June 13.

All preparations have been made for the issuance of the *Convention Daily* on June 11, 12, 13 and 14 along the lines of previous years, but with some new features, and it was also announced that the Seattle Electric Company will devote its journal to a special pictorial issue illustrative of central-station power-plant development on the coast and the scenery of Seattle and its environs. A number of other incidental matters were discussed at the two long sessions held on April 5, and these meetings were followed by meetings of sub-committees.

ARRANGEMENT FOR SOUTHWESTERN CONVENTION AT SAN ANTONIO, TEX.

The eighth annual convention of the Southwestern Electrical and Gas Association will be held at the St. Anthony Hotel, San Antonio, Tex., April 25, 26 and 27. Among the papers to be presented are the following: *The Benefit of the Interurban to the Community*, by Mr. R. B. Stichter, general manager Texas Traction Company, Dallas; *History of Street-Railway Development in Texas*, by Mr. T. C. Brown, San Antonio Traction Company; *Theft of Electric Energy and Gas*, by Mr. Harold L. Geisse, San Antonio Gas & Electric Company; *Public-Service Corporations and State Development*, by Mr. Louis J. Wortham, Fort Worth; *Prepayment Meters, Their Advantages and Disadvantages*, by Mr. George M. Griffith, Galveston Gas Company; *The Relation of Power-Factor to Central-Station Costs*, by Mr. Frank M. White, manager Amarillo Water, Light & Power Company; *The Distribution of Electricity from the Central Station*, by Mr. A. D. Brinkerhoff, Waco Electric & Gas Company, and *Relations That Should Exist Between the Public and Public-Service Corporations*, by Mr. E. W. Kellogg, Jr., manager El Paso Electric Street Railway. There will also be "Question Box" discussions, etc.

During the days of the convention an electrical exhibit will be held in the large ballroom of the hotel, admission to which will be free to members and the public. A committee, of which Mr. Martin Wright, Bedell Building, San Antonio, is chairman, has the show arrangements in charge. San Antonio is a picturesque resort city, with splendid modern hotels, and contains the famous Alamo and other Spanish ruins. It has been the scene of many stirring events in Texas history. A number of excursions are planned to points of interest as entertainment features of the convention. Mr. W. B. Tuttle, 305 Houston Street, San Antonio, or Mr. David G. Fisher, secretary of the association, 1316 Commerce Street, Dallas, may be addressed for further information concerning the convention arrangements.

Resuscitation from Electric Shock.

A sub-committee of the Commission on Resuscitation from Electric Shock has formulated a set of rules, which draft is now before the members of the commission for their consideration. One set of rules will be issued in chart form for posting in electrical generating plants, substations, etc., and another set, going somewhat more into detail, will be issued in pocketbook form for the use of electrical employees, and particularly of linemen.

A. I. E. E. AFFAIRS.

At the meeting on April 5 of the board of directors of the American Institute of Electrical Engineers seventy-two associates were elected, seventy-eight students enrolled, and the following associates transferred to the grade of member: Messrs. Edward E. Clement, Washington, D. C.; Vladimir Karapetoff, New York; B. Parks Rucker, Charlotte, N. C.; John H. Morecroft, New York, and H. M. Gassman, Birmingham, Ala.

Upon recommendation of the sections committee the organization of a branch was authorized at Lafayette College, Easton, Pa. Mr. Richard O. Heinrich, of Berlin, Germany, a member of long standing who for many years has been active in the interests of the Institute, was appointed local honorary secretary of the Institute for Germany. The president announced that arrangements were being made for the presentation of the Edison Medal to Mr. George Westinghouse, to whom it had been awarded by the Edison Medal committee last December at the Boston convention of the Institute, June 24-28.

The president announced the death of Prof. Antonio Pacinotti, of Pisa, Italy, one of the honorary members of the Institute.

The board unanimously adopted the following resolutions:

"The board of directors of the American Institute of Electrical Engineers learns with extreme regret of the death, on March 24, 1912, of Prof. Antonio Pacinotti, of Italy, an honorary member of this Institute, and desires to place on record its sense of the loss sustained.

"This death removes a historic figure whose name will always occupy a great place in the annals of electrical progress, for his discovery in 1860 of the principles of the modern continuous-current dynamo and its reversibility.

"The board of directors, in behalf of the membership of the American Institute of Electrical Engineers, hereby tenders its profound sympathy to the relatives of the deceased, to his colleagues, and to the Associazione Elettrotecnica Italiana for the loss of its honorary president."

The New York reception committee reported that Mr. C. E. L. Brown, an honorary member, had arrived in New York on Sunday morning, March 31. As a mark of recognition by the Institute of his presence in New York, and for the purpose of presenting him with his certificate of honorary membership, a formal dinner had been planned for Thursday, April 4. Mr. Brown having found it necessary to sail for Europe on April 3, a dinner attended by members of the board of directors and several past-presidents was tendered him instead on the evening of Monday, April 1.

The president again referred to the importance of coordinating the activities of the various branches of electrical engineering and of the Institute's entering into more intimate reciprocal relations with existing electrotechnical societies. This policy had been the subject of favorable discussion at previous meetings, and resolutions commending it were adopted. Upon the invitation of Mr. Thomas N. McCarter, president of the American Electric Railway Association, the president was authorized to appoint three representatives of the Institute upon a committee of the American Electric Railway Association and other organizations to consider the joint use of poles. The president appointed as the Institute's representatives upon this committee Messrs. Farley Osgood, of Newark, N. J.; Percy H. Thomas, of New York, and F. B. H. Paine, of Buffalo, N. Y.

Discussion of a proposed mid-winter convention in New York in 1912-1913 led to the passing of a resolution expressing the opinion of the board that the interests of the Institute would be promoted by the holding of a general convention at Institute headquarters between Jan. 1 and April 1, 1913.

The committee on relations of consulting engineers submitted a report, and in accordance therewith a resolution was adopted authorizing the committee to prepare a code of fees and rules of procedure and to confer with similar committees of other societies composed in whole or in part of consulting engineers. The president was authorized to appoint advisory members to the committee.

Ratification of the Berlin International Wireless Telegraph Convention.

After more than five years of delay Congress ratified on April 3 the Berlin international wireless-telegraph convention, which was signed in Berlin on Nov. 3, 1906, by the representatives of twenty-seven countries. Since 1908 the other signatory powers represented at the Berlin conference have all ratified the convention, including Great Britain, France, Germany, Austria, Russia and Japan. At recent hearings before the Senate committee on foreign relations and the House committee on commerce, arguments and briefs were submitted by representatives of the commercial companies and by the government departments.

Rear-Admiral Edwards of the United States Navy pointed out in his testimony before the committees, in reply to objections to the conference from commercial companies, that progress in the wireless art has been neither discouraged nor retarded in countries which operate their coastal stations under the service regulations of the Berlin convention. He further pointed out that our postponement of action has caused surprise, if not amazement, and might even be construed as a breach of faith. A study of the convention brings out the conclusion that its provisions rest on broad humanitarian considerations, such as practically to compel our ratification.

EXPERIMENTS IN "WIRED-WIRELESS" TELEGRAPHY.

The April number of the *Journal* of the Franklin Institute contains an interesting article by Major George O. Squier, of the Signal Corps, entitled "Some Experiments in 'Wired-Wireless' Telegraphy for Field Lines of Information for Military Purposes." For years the well-known "buzzer" method of transmitting code signals over a field wire has been standard, and it is now employed for infantry and mixed commands. This has been supplemented by pure radio-communication for rapidly moving troops such as cavalry. The latest apparatus of the Signal Corps for wireless operation consists of a 500-cycle low-power generator designed for aëroplanes and "pack" sets, with a special transformer and a quenched spark-gap.

It has been found that by a proper method of inductive coupling the 500-cycle signals can be superposed on a "buzzer" field line, with very satisfactory results. And, furthermore, the same wire can be used to guide the high-frequency waves from the complete field wireless set. The method of coupling is described in the paper at some length, with diagrams. The author states these conclusions:

"(*a*) The standard insulated field wire furnished to the

Signal Corps, when paid out on the ground and normally operated by the standard field buzzer, may be efficiently used to transmit Morse signals by electric waves by connecting it directly or inductively to the 500-cycle generator supplied for the wireless equipment, and the signals may be interpreted at the receiving end of the line by the standard low-resistance telephone.

"(*b*) This same wire may also be used to guide the high-frequency electric waves transmitted by the complete field wireless quenched-spark sending set and received by the complete wireless receiving set with the usual detector and high-resistance telephones. This gives three well-defined and distinctly separated methods of transmitting intelligence over wires, and permits the possibility of using them either separately or in any operative combination in accordance with the particular requirements of the case. The above results can be accomplished without the addition of a single piece of apparatus over what is already in the hands of the field companies of the Signal Corps."

PROGRESS OF WORK ON THE KEOKUK WATER-POWER PROJECT.

The progress of work on the great Keokuk water-power project on the Mississippi River has been described from time to time in these columns, and a bulletin recently issued by the Mississippi River Power Company, which is carrying on the development, describes the general progress of work since the middle of November last. It will be recalled that the work as a whole has been separated into two divisions, one of which is operating from the Illinois side and engaged only in the construction of the dam, while the other is operating on the Iowa side, building the intake, the power station and the new government lock.

Out of a total of 119 piers in the main dam, the work is now completed up to and including Pier 82. Notwithstanding the exceedingly severe character of the past winter, the work progressed quite satisfactorily except during the month of January, when a cold wave of exceptional length and severity was experienced. Cofferdam No. 3 is now completed and pumped dry, and upon the completion of the dam in this section there will remain a gap in the river of but 450 ft. to close. This will be accomplished in the same manner as heretofore, and the stream flow will be diverted through the openings of the completed piers toward the Illinois shore. The spillways between the piers have been completed only for a small portion of the dam which now lies on the Illinois shore. The remaining spillways will not be completed to their full height at once, but will be raised in succession about 5 ft. This will be accomplished by forming a box under each arch, composed of the pier walls and two gates, one of which will be placed over the up-stream opening and one down-stream. After all of the spillways have been raised to this initial height another lift will be made in the same manner as the first one, thus avoiding excessive depths of water during the work, and at the same time permitting the gradual filling of the pond which will ultimately extend some 60 miles above the dam.

The initial wheel installation will consist of fifteen 10,000-hp turbines of the Francis type, and the ultimate installation will comprise thirty of these units. The draft tubes for the initial installation are complete, and also seven of the wheel chambers. The other eight wheel chambers are partly finished. Six pit liners, each weighing assembled 106 tons, are also in position and the concrete is being placed around them. The power-house superstructure will be built of reinforced concrete. Excavation work on the tailrace with two steam shovels is also under way.

The many changes which are necessary in shore property for a number of miles north of the dam are rapidly being taken care of. All of the property owners whose flowage rights are required for the initial operation of the project have been settled with, and the raising of the tracks of the Chicago, Burlington & Quincy Railroad for a distance of 14 miles is now under way.

The bulletin contains a general description of the principal features of the 10,000-hp turbines which will comprise the initial wheel installation. The normal capacity of each turbine with 32 ft. of head will be 10,000 hp. The total weight of each turbine with its casing will be approximately 500 tons, and the weight of the runner, together with the revolving element of the direct-connected vertical-shaft generator, will be approximately 275 tons. The normal speed will be 57.7 r.p.m. The greatest care has been given not only to designing these turbines for maximum efficiency but also to the problem of leading the water to and from the turbines with the least possible loss of effective head.

WATER-POWER DEVELOPMENT.

With the purpose of advancing the industrial interests of southern Minnesota, the Southern Minnesota Development Association has been formed, holding its first meeting at Mankato on April 2. Mr. H. M. Byllesby was invited to address the meeting, but was unable to be present in person and was represented by Mr. Errett L. Callahan, of Chicago, manager of the new-business department of Messrs. H. M. Byllesby & Company, who spoke on "What Water-Power Development Means to Southern Minnesota." Mr. Callahan remarked that his company is interested in water-power development in southern Minnesota to the extent of several million dollars. His company has built and placed in operation the largest two hydroelectric developments in the region and is now trying to find a market for the greater part of the 6000 hp created. At the present time the Byllesby interests can supply six times as much electrical energy as is being used in Mankato, Faribault, Northfield, Cannon Falls and the other communities served by the water-power developments at Rapidan and Cannon Falls.

At present practically all water-powers in southern Minnesota of a size sufficient to warrant development have been developed. With the advent of additional industries the smaller water-power possibilities, coupled with existing developments, may be utilized. However, with the present 10,000 developed horse-power in southern Minnesota, a network of interurban electric-railway lines is assured for that section, and these roads will serve to develop agriculture and manufacturing.

The speaker referred to the beneficial industrial results of electric-power developments in various portions of the country, as in South Carolina, where the Southern Power Company has accomplished wonders in stimulating the cotton-mill industry. The example of Niagara Falls is of course well known, and the Cripple Creek and Goldfield gold-mining districts of Colorado would not be worked at all to-day were it not for low-priced central-station electric power. Central-station energy makes profitable the mining of low-grade ore. A Byllesby company in that region is now completing a 65-mile transmission line to serve the towns and farms in the rich irrigated valley of the Arkansas River. Coal mines are operated also with electric power, and one motor-driven cement mill alone requires 2500 hp.

Near Dundas, Minn., six farms have just been connected to the transmission line from Cannon Falls. At Butte, Mont., hydroelectric energy is carried 200 miles and used in operating the copper mines and mills to a larger proportionate extent than in any other place in the world. A development of 100,000 hp is being made on the New River in Virginia. Energy will be transmitted 60 miles to Roanoke and used for varied industries. Another transmission line will run to the great Pocahontas coal fields, where it is said that 75,000 hp in steam engines is to be supplanted by electrical energy, 30,000 hp of which is now under contract.

CONCENTRATED ELECTRICAL ENERGY PRODUCTION.

At a meeting of the American Institute of Electrical Engineers held in New York on April 5 Mr. Samuel Insull, president of the Commonwealth Edison Company, of Chicago, presented an illustrated paper entitled "The Relation of Central-Station Generation to Railway Electrification." The author showed, by means of load diagrams and statistics obtained from various sources, that the amount of energy required for transportation in any given community represents only from 15 to 20 per cent of the total amount of energy required. He claimed that the amount of energy for operating the terminal and suburban systems of all the trunk lines centering in and around New York City is less than the amount required to operate the isolated electric-lighting plants in the same territory. He argued that by consolidating into a few favorably located stations the generation of energy for the different communities throughout this country there would be saved the equivalent of from 200,000,000 to 250,000,000 tons of coal per year.

The concentration of the production of energy for all purposes required in a given area of population would result in such a saving in capital and operating expenses as to provide for the generating equipment and primary transmission systems necessary to electrify the terminal systems and suburban service of all trunk lines centering in and around any large center of population, and particularly Greater New York. The percentage of saving in Greater New York would be comparatively small, but the saving in the aggregate would represent such a vast sum of money, when properly capitalized, that it affords one of the greatest opportunities at present existing in the line of central-station supply.

Throughout the New York neighborhood the total load on systems considered separately is 678,000 kw. There is a diversity factor of the loads, however, such that if it were supplied from a single system the load would amount to only 630,000 kw, thus representing a saving by consolidation of upward of 47,000 kw. The diversity factor amounts to 7.5 per cent, and the load factor of the combined system would be 40 per cent, as compared with 36.9 per cent for systems operated separately. Numerous diagrams were shown of the loads carried by electric railway and lighting systems of the New York, Chicago and Boston neighborhoods. In the New York neighborhood the total load on the systems of the various lighting companies is 232,500 kw. The annual load-factor of the various systems considered separately is 33.8 per cent, and there is a diversity factor of 17.5 per cent, thus showing that a considerable saving in equipment is to be obtained by consolidating the systems and supplying energy from one common generating point. The daily load-factor of the New York stations operated separately is 51 per cent. If they were operated together, the daily load-factor would be 56.2 per cent. It was estimated that if all of the steam railroads in the vicinity of New York were operated electrically, in both their freight and passenger services, only about 170,000 kw would be required. Mr. Insull claimed that by operating the systems in Greater New York as a unit rather than separately from $18,000,000 to $20,000,000 could be saved in investment. The saving in operating expenses of such consolidation would amount to about $1,000,000 per year. Taking into account the fixed charges, depreciation and interest, the change would represent the creation of about $60,000,000 in value.

In the Boston neighborhood the maximum load last winter for both the lighting and railway services considered separately was 111,200 kw. If this load had been supplied from a single system, it would have amounted to only 95,400 kw, the diversity factor being 16.5 per cent between the railway and lighting businesses. If the railway system and the lighting system were operated together, the average load-factor would be 59.4 per cent; operating separately they provide an average load-factor of 53.9 per cent.

The author presented estimates showing that if all the electric supply systems in Chicago, including steam railways, obtained their energy from a single generating system the saving would amount to from $10,000,000 to $12,000,000. It was estimated that the combined freight and passenger service would have a 46 per cent daily load-factor. Records kept for a number of years show that the lighting and motor service business in Chicago has an annual load-factor of less than 35 per cent, and the street railway service load-factor is about 43 per cent. The combined load-factor of the two is about 42.5 per cent. The average daily load-factor for the different systems operating separately is 55.6 per cent. The load-factor for all combined in one generating system is 59.9 per cent, or an increase of 7.4 per cent.

Discussion.

Mr. John W. Lieb, vice-president of the New York Edison Company, called attention to the fact that the load-factor of central stations as at present operated is very high, on account of the diversity factor of the equipments to which energy is supplied. He predicted a certain amount of difficulty in supplying energy for all purposes from a common generating system, by reason of the great differences in the uses to which the energy would be put, such as 15 cycles for railway work, 25 cycles for railway and lighting, 60 cycles for another part of the lighting load, and direct current at different voltages for railway and lighting services.

Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, claimed that only by viewing the problem of energy supply in the broad way adopted by Mr. Insull can the cities of the future be maintained as inhabitable places.

Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, said that, according to estimates, about 60,000 kw would be required to supply all of the energy necessary to operate trains on the New York, New Haven & Hartford Railroad from New York City to Boston. This amount seems small in comparison with from 600,000 kw to 700,000 kw utilized in central stations around New York City.

Dr. C. P. Steinmetz, Schenectady, N. Y., claimed that the paper by Mr. Insull announced the approach of a new era in the electrical industry, the change being one from diversified electric generating systems or diversified classes of work to electricity as the universal source of power serving the whole community.

Mr. L. B. Stillwell, New York, stated that while a considerable improvement in diversity factor is obtained when several small lighting plants are combined as one, yet not much improvement in this respect is to be obtained if several very large plants are combined. Thus, there is a practical limit to the combination of generating systems. Another limit is encountered by the diversity of voltage, and still another by the several frequencies in commercial use. The carrying out of the idea of centralization of generation is rendered easier by reason of the enforced substitution of more efficient modern units for the older less efficient units, at which time consolidation can easily be brought about.

Mr. B. F. Wood, electrical engineer of the Pennsylvania Railroad Company, stated that the generating stations for the New York terminal electrification of the Pennsylvania represent an expenditure of about $4,000,000. If energy could have been purchased in New York as cheaply as it is being sold in Chicago, this expenditure of $4,000,000 could have been avoided, and a dividend of about 6 per cent could have been paid on the $4,000,000 invested in other electrical work, including locomotives.

Dr. Cary T. Hutchinson, New York, stated that unless the central stations will sell energy at a price less than railways can produce it at their own plants, nothing can be gained

by the railways in obtaining energy from the central stations.

Mr. Bion J. Arnold, Chicago, stated that the consolidation of the generating equipment tends to lower the capital costs, and even though the station cost were the same, the large station can sell energy more cheaply than the small station can produce it. This statement was based on a study recently made in connection with the supply of energy in a city where the municipal ownership advocates are very strong. It was found that the railway company could purchase energy at 0.75 cents per kw-hr. delivered to its substations, which price was less than that at which it could produce energy in its station with coal at $1.80 per ton, taxes 1.5 per cent per annum, interest at 6 per cent and depreciation at the equivalent of 5 per cent per annum. The larger station can sell energy more cheaply than it can be made in small plants by taking advantage of skilled management, skilled engineers and smaller investment per kilowatt for the large units.

Mr. Frank J. Sprague, New York, asserted that if New York as it exists to-day could be blotted out and re-created to-morrow not a single isolated plant would be installed. It would be planned so that not only the lighting and the motor service, but a large portion, or perhaps all, of its heating would be supplied from a few great central stations.

CLOSED-FUSE DESIGN.

Closed-fuse design was the subject for consideration at the regular meeting of the Luncheon Club branch of the New England Section of the N. E. L. A. at Boston on April 5, the speaker being Mr. L. W. Downes, general manager of the D & W Fuse Company, Providence, R. I. The attendance totaled 175. Mr. Downes gave an interesting talk upon the principles of fuse operation, and touched upon the importance of preventing explosive action by proper proportioning of the fuse parts, and the connection between accuracy of operation and the length, section, number and arrangement of links carried in inclosing material. The use of notching and the air-drum principle were also described. It has been found that the volume of metal inclosed in the cartridge should not exceed 1 per cent of the volume of the inclosing tube, if explosive action in 600-volt fuses is to be prohibited. The extension of the fuse surface to the maximum degree, notably by the use of parallel strips of metal, increases the reliability of the device and cuts down the energy absorbed in blowing. The use of the multiple link reduces the amount of metal required for a given capacity by 26 per cent, requires the gases to travel a shorter average distance before condensation and saves from 23 to 25 per cent in energy absorbed in the case of a five-strip fuse compared with a single-strip unit.

Mr. Downes dwelt at length upon the great value of oscillographic tests in the investigation of fuse action and exhibited several enlarged oscillographs of fuse performance under different conditions. A comparison between a five-strip, 80-amp fuse and a single flat-strip fuse short-circuited on 600 volts direct-current supply showed that in the first case the instantaneous short-circuit current was 8415 amp and in the second case 9390 amp. The energy absorbed was 28,600 watt-seconds with the multiple-strip fuse and 58,000 watt-seconds with the flat strip. With the flat-strip fuse there was an undesirable inductive rise in potential before the circuit was finally ruptured. An oscillograph of a fuse blown upon an inductive circuit showed an average current of 4700 amp during the rise of the metal temperature to the melting point. Mr. Downes reviewed the difficulties of fuse design in relation to the control of high-tension circuits, and said that late researches indicate that prolonged arcing in the case of high-tension fuse operation is due to the extended period of time of current flow before vaporizing, which results in the heating of the filling to a point which considerably increases its conductivity, the arc then being maintained along the lines of a "Nernst" effect in the filling material. Closing, the speaker advocated patronizing one of a group of half a dozen or more fuse makers who are giving scientific study to the problem of design, and contended that no reloadable fuse has as yet been developed which conforms to the requirements of the Underwriters.

UNIT GENERATING AND DISTRIBUTION COSTS OF THE PACIFIC GAS & ELECTRIC COMPANY IN SAN FRANCISCO.

Among the arguments submitted by the Pacific Gas & Electric Company to the Board of Supervisors of the city and county of San Francisco, in connection with the pending regulation of rates for gas and electric energy, are some interesting statistics concerning the unit costs of generation and distribution. About 91 per cent of the generated energy is developed in steam-driven stations and the rest is received by transmission from hydroelectric sources, which are depended upon for emergency standby. The condensed operations for 1911 are given in the accompanying table.

TOTAL PRODUCTION, REVENUES AND COSTS IN SAN FRANCISCO FOR 1911.

Kilowatt-hours generated by steam		85,707,854
Kilowatt-hours received by transmission		7,787,959
Kilowatt-hours, total production		93,495,813
Kilowatt-hours sold		68,797,090
Per cent lost in distribution		26.5
Revenue from sales		$2,730,248
Cost of generation	$729,315	
Cost of distribution	347,182	
Cost of administration and distribution	943,363	
		2,019,860
Net earnings		$710,388

The average revenue per kw-hr. for all energy sold was 3.969 cents and the average total cost was 2.936 cents, including depreciation, leaving a net revenue of 1.033 cents. A valuation of the entire electric properties as of Dec. 31, 1911, by Messrs. J. G. White & Company, with no allowances for stores and supplies, working capital, franchise value or going value, gave a total of $11,152,006, made up as follows: $624,356 for real estate; $3,577,238 for steam generating stations; $1,190,299 for substations; $4,963,522 for the distribution system; $615,450 for electric meters and miscellaneous, and $181,141 for miscellaneous electric properties. On this total valuation the net rate of return in 1911 was 6.4 per cent. The unit costs in detail appear in the table shown herewith.

UNIT COSTS FOR 1911.

	Cents per Kw-hr.	
Generation:		
Labor	0.225	
Materials	0.731	
Repairs	0.104	
		1.060
Distribution:		
Labor	0.216	
Materials	0.098	
Repairs	0.191	
		0.505
Administration:		
Labor	0.271	
Materials	0.082	
Legal expenses	0.021	
Fire insurance	0.005	
Bad debts	0.026	
Advertising	0.008	
Damages to persons	0.005	
Rents	0.005	
Taxes	0.153	
		0.576
Interest on floating debt		0.006
Depreciation		0.789
Total		2.936

Next to generation, the largest major item is depreciation the gross amount of which is equal to 4.9 per cent on the valuation stated above. The combined cost of distribution and administration is substantially equal to the cost of generation.

Typical station load curves submitted show that the summer instantaneous peak was 1619 kw, accompanied by a load factor of 29.1 per cent, while the winter peak was 2363 kw and the load factor 38.9 per cent. Practically the entire distribution is alternating current.

Present rates in San Francisco range from 9 cents to 3 cents per kw-hr., and these extremes apply both to lighting and to motor service. Oil fuel, used exclusively, cost an average of 83 cents per barrel in 1911. Comparisons of these rates with those in twenty-one of the principal cities of the country were submitted to the board, with the object of showing that San Francisco enjoys rate advantages over many other large municipalities. The company states that the present rate of return on the San Francisco investment is less than 6 per cent.

ANNUAL REPORT OF THE PUBLIC SERVICE CORPORATION OF NEW JERSEY.

The third annual report of the Public Service Corporation of New Jersey, for the year ended Dec. 31, 1911, is much more comprehensive than either of its predecessors. This company is a holding concern for the Public Service Gas Company, the Public Service Electric Company and the Public Service Railway Company, whose operations for the year are included in the general statement. The combined fiscal operations of the parent and subsidiary companies for the year just closed are presented in the accompanying table.

FISCAL OPERATIONS FOR 1911.

Revenues		$30,125,508
Operating expenses and taxes	$15,941,691	
Amortization charges	672,654	
		16,614,345
		$13,511,163
Other income		1,890,513
Total net income		$15,401,676
Interest and rentals		11,066,651
Fixed charges of Public Service Corporation		2,540,243
Surplus		$1,794,782

The gain in revenues over 1910 amounted to 8.9 per cent. Distribution of the revenue among the three subsidiary companies shows that the railway properties earned 48 per cent of the total, the gas properties 30 per cent and the electric properties 22 per cent. The condensed balance sheets of the four companies reveal total assets as shown below, offset in each case by equal liabilities:

	Total Assets.
Public Service Corporation	$77,387,770
Public Service Gas Company	9,831,940
Public Service Electric Company	11,873,755
Public Service Railway Company	85,850,882

Dividends on the $25,000,000 outstanding stock of the parent corporation at the annual rate of 6 per cent were paid during the year. The requirements for new capital were met by the sale of $13,860,000 face-value 5 per cent general-mortgage fifty-year bonds, making the total issue outstanding equal to $30,000,000. The proceeds were applied to extensions of property in the three subsidiary companies.

During the year the parent concern acquired nearly all of the capital stock of the Shore Lighting Company, which controlled the electric lighting business in Red Bank, Monmouth County and vicinity and the gas business at South Amboy. The gas properties of this company and the Princeton Light, Heat & Power Company (acquired in 1910) were leased to the Public Service Gas Company. The electric properties of these two companies and those of the Burlington Electric Light & Power Company, acquired in the same year, were leased to the Public Service Electric Company. Franchises were also obtained for the distribution of gas in Madison and Morris Plains.

The most notable addition to the properties during the year was the new generating station at Perth Amboy, which is a thoroughly modern plant. It is designed to care for the rapidly increasing load in the central division. Additional lines were placed underground during the year in accordance with the policy of the company to carry out a certain amount of this work each season. The construction of additional transmission lines has made it possible to shut down several of the less important or inefficient generating stations.

The Public Service Electric Company serves 72,727 customers in a population of 1,923,000. The connected load at the end of the year was 156,202 kw and the energy sold during the year was 103,145,000 kw-hr. The entire revenues of the electric company amounted to 6.3 cents per kw-hr. sold. The Public Service Gas Company serves a population of 1,809,000, among which it distributed 8,895,000 cu. ft. of gas during the year, there being 388,606 meters in service at the end of the year. The revenues of the gas company amounted to $1.01 per 1000 cu. ft. sold. The railway company carried 362,600,000 passengers, in a territory having a population of 1,749,000, and received an average fare of 3.82 cents per passenger, or 31.07 cents per car mile.

PUBLIC SERVICE COMMISSION NEWS.

NEW YORK COMMISSION.

On the application of the New York Railways Company, successor to the Metropolitan Street Railway Company, the New York Public Service Commission for the First District has granted a rehearing, to be held April 19, on the order of the commission issued Feb. 27, 1912, directing the company to maintain an amortization fund of $108,000 a year, invested so as to produce at least 4 per cent interest, until the fund shall amount to $16,500,000, and also directing the company to maintain a depreciation fund each month equal to at least 20 per cent of its gross operating revenue. The company asks for a rehearing on the ground that $16,500,000 does not represent the difference between the value of its property and the face value of the stock and bonds issued, and asserts that the property value is greater than such face value. It also contends that the commission made no allowance for the value of the company's franchises and asks leave to prove the value of such franchises. The petition also challenges the correctness of the figure, 20 per cent of gross operating revenue, for depreciation and maintenance and alleges that the company is maintaining its property in good condition and expending thereon such amounts as are required. It also alleges that the commission acted beyond its powers in making the order.

Counsel for the organizations of stationary engineers, which have been endeavoring for some months to prove before Commissioner Maltbie, of the First District, that the rates of the New York Edison Company are unreasonably discriminatory, presented the argument in his case on April 8. He contended that the company sold energy below cost to some customers whose large consumption might justify the use of an isolated plant, and that the loss thus incurred by the company was returned to it through the high rates charged to consumers of small amounts of energy. He requested that the commission pursue an investigation on its own initiative, in order to determine the assets of the company, that the cost of supplying energy to all classes of customers be ascertained, and that a new schedule of rates be adopted, which would be proportionate to the cost of manufacture, so that the price to customers of each class would be based on cost of production plus a reasonable profit. In regard to another petition filed by

an isolated-plant publishing company which has secured power of attorney to act for a few retail customers of the Edison company, Commissioner Maltbie ruled that hearings on this petition would be joined with those on the original complaint, noted above, and that decision in the first case would be reserved until hearings had been concluded on the second.

The commission for the First District recently transmitted a letter to the Edison Electric Illuminating Company of Brooklyn in the matter of the discontinuance of service furnished to William Bradley, one of the contractors for the Fourth Avenue subway in Brooklyn, disagreeing with the company's interpretation of the transportation corporations law, which had been cited by the company in defense of its action. At a previous hearing it developed that the Edison company discontinued service to the contractor because of a dispute over payment of a bill of about $6,000, which the company rendered for reconstruction of that part of its conduit system which was disturbed by the construction of the subway. At the hearing the representatives of the company promised that in the future they would not discontinue service without notifying the commission in ample time to protect the city from any danger which might result from consequent interruption to the work. The commission in its communication to the company takes the position that the transportation corporations law does not authorize the discontinuance of service because of a difference over a charge for an extraneous matter, treating as secondary in this case the question of whether a public-service corporation may suddenly discontinue service without regard to possible danger to life, property or the public health.

The Public Service Commission for the Second District has denied the application of the New York Central & Hudson River Railroad Company for permission to acquire a majority of the stock of the New York, Ontario & Western Railway Company. This case is of considerable interest because of the principles which it involves. The commission states that the transfer of the bare majority interest, now held by the New York, New Haven & Hartford Railroad Company, to the New York Central should not be permitted without reasonably guarding the minority stockholders. Apparently there is no way to accomplish this except by imposing the condition that the New York Central shall take over, on the same terms per share as it pays the New Haven company, all of the minority stock which may be offered. This, in the opinion of the commission, would impose a burden upon the New York Central which lacks sufficient advantages to warrant the transaction. The commission points out that the proposed acquirement of stock would bring about the control of a small railroad by a great system which is to some extent competitive, and would thus to the same extent eliminate competition. It is also stated that, in the judgment of the commission, the energies and the credit of the New York Central are greatly needed in the discharge of the public duties and burdens with which it is now charged and in the solution of the numerous complicated problems pressing upon it in connection with the proper growth and development of the present property. The possibility that the taking over of the majority interest in the stock of the Ontario & Western might become a considerable burden on the New York Central is illustrated by the fact that for the five years immediately past the net income of the Ontario & Western has been progressively diminishing. The denial of this application is based primarily on the grounds that the business prospects of the Ontario & Western do not warrant the purchase and the fact that the present financial situation of the New York Central does not justify the action. It is also pointed out that the proposed purchase price is somewhat above the present market value of the stock, and furthermore the proposed purchase might establish a condition which would embarrass the minority stockholders. The matter of the possible elimination of competition is not discussed in view of the other grounds for rejecting the application, which the commission regards as entirely adequate for sustaining its decision.

The commission has received an application from the Syracuse Lighting Company for authority to issue $220,000 par value of its extension and improvement 6 per cent ten-year gold bonds, the proceeds to provide for the laying of trunk mains, for extensions to the distributing system and for improvements at the works and stations.

WISCONSIN COMMISSION.

The annual report of the Railroad Commission for the year ended June 30, 1911, has been completed. The total number of plants making report to the commission was 990, of which 193 were electric, 54 gas, 126 water, 603 telephone and 14 heating utilities. During the year the commission heard 703 cases as against 864 for the preceding year. Of this number, 452 were railroad cases, 98 formal and 87 informal utility cases. A total of forty-two decisions in formal utility cases were issued, of which twenty-five involved rates, seven service, six rules and regulations and four related to municipal purchase. Sixty-three formal utility cases were pending at the close of the fiscal year. The report notes that five appeals from the rulings of the commission were taken to the courts, only one of which concerned an electric utility. Thirty-four amendments to rate schedules were submitted by electric utilities, which amounted to reductions in practically all instances.

During the year fifty-three applications were filed and certificates issued under the stock and bond law for a total of $44,624,328 of stocks, bonds and other evidences of indebtedness. Of the total, the following were for electrical corporations: Stocks, $3,056,200; bonds, $6,591,000; promissory notes, $200,000. For combined electric light and railway companies, $1,606,000 in stocks and $12,520,000 in bonds were authorized. Traction companies were authorized to issue $2,050,000 in stocks and $4,133,000 in bonds.

The report calls attention to the more important legislation especially affecting the telephone utilities, such as the law requiring the physical connection of telephone systems whenever public convenience and necessity require such connection and the extension of the provision preventing the duplication of utilities doing the same kind of business to include telephone utilities. Attention was called to the fact that the stock and bond law has been amended so as to include the telephone utilities under its provisions.

In discussing the development of the public-utility business during the year it was noted that the gross earnings for all utilities making report aggregated $17,011,280—an increase of 13.2 per cent, as against an increase of 12.66 per cent for the year ended June 30, 1910. The gross income available for return upon capital showed an increase of 14.05 per cent, and the net earnings from operation amounted to $5,623,716, or an increase of 13.18 per cent. The plant value of all utilities reporting aggregated $106,111,174, or an increase of 10.07 per cent, as against an increase of 12.25 per cent for the preceding year. As an offset to the total plant value, bonds were outstanding aggregating $45,433,080, or an increase of 16.96 per cent, and the capital stock outstanding amounts to $48,625,069, an increase of 6.93 per cent, as compared with an increase of 16.32 per cent for the previous year.

An inspection of the tabulated returns of the electric public utilities shows that plant values aggregate $39,429,688, or an increase of 22.13 per cent; outstanding stock aggregates $20,177,635, or an increase of 18.8 per cent; bonds outstanding amount to $22,400,307, or an increase of 34.56 per cent; total operating revenues amount to $5,629,103, or an increase of 26.68 per cent; income available for return upon capital showed an increase of 24.29 per cent. The total plant value of gas utilities was given as $25,131,572, an increase of 2.06 per cent, and the income available for return upon capital showed an increase of 5.8 per cent.

Telephone utilities showed a total plant value of $16,621,370, or an increase of 5.2 per cent. The capital stock outstanding, however, showed a decrease of 0.02 per cent and the bonds outstanding a decrease of 10.36 per cent. Total operating revenues increased 9.46 per cent and the income available for return upon capital increased 15 per cent. When a comparison was made of the relative prosperity of municipal and privately owned electric plants, it was noted that whereas the plant values of the 140 privately owned utilities increased 22.06 per cent, those of the 53 municipally owned utilities increased 25.1 per cent.; gross earnings increased 27.28 per cent and 19 per cent respectively, and gross income available for return upon capital increased 24.15 per cent and 26.7 per cent respectively.

The report this year is increased in scope by the addition of a separate section made necessary by the large number of statistical summaries and unit-cost compilations. Unit values for all phases of utility operation, covering each electric, gas, telephone or water company reporting to the commission, have been compiled for each of the last three years. The Southern Wisconsin Railway Company has applied to the commission for a rehearing upon that part of the recent order which required the establishment of a faster schedule by July 1, 1912. It was contended that, inasmuch as this question was not one of the issues at the hearing, no testimony was introduced concerning it, and that furthermore it would be impossible to comply with the terms of the order within the time specified. The hearing was set for April 12.

MARYLAND COMMISSION.

The Maryland Public Service Commission last week resumed the hearing on the complaint made by the Baltimore Electrical Supply Company against the Consolidated Gas, Electric Light & Power Company, which was filed with the commission several months ago. Mr. Herbert A. Wagner, vice-president of the Consolidated, and in charge of the electrical division of that company, gave his testimony at length in reference to the house-wiring business which his company has received. Mr. Wagner said that from September, 1910, to September, 1911, his company had wired 184 houses out of a total of 313; or, in other words, the Consolidated had received about 60 per cent of the house-wiring done in that year. This is limited to old houses, since the Consolidated company does not bid on wiring in houses under construction.

Counsel for the complainants laid particular emphasis on the fact that the Consolidated company, although it had been in the house-wiring field for only one year, nevertheless had been able to secure 60 per cent of the business. During the course of the hearing it was brought out that the Baltimore schedule of prices for the wiring of houses appeared in an article in the March 9 issue of the *Electrical World*, entitled "Standardized Interior Wiring Prices," by H. L. Parker.

The commission has arranged a conference with the officials of the Chesapeake & Potomac Telephone Company to take up the matter of ambiguities in the schedule of rates ordered by the commission. This conference is the result of numerous complaints made to the commission by telephone subscribers.

Chairman Laird of the commission has promised that as soon as possible after Governor Goldsborough signs the bill giving the commission power to compel the United Railways to issue commutation tickets to Baltimore suburbanites the commission will proceed to take up this whole question on a broad and comprehensive basis.

Recently the commission ordered the Western Union Telegraph Company to restore its office in the Hotel Belvedere, which but shortly before it had abandoned. The telegraph company has now appealed from the order of the commission to the Circuit Court and has asked for an injunction to restrain the commission from enforcing its order. This case is of special interest, being the first instance of an appeal from an order of the commission. Counsel for the telegraph company stated to the court that unless the injunction is granted any complainant can arbitrarily force the telegraph company to establish an office at any designated place, regardless of whether the office shall be profitable. Counsel also stated that when there is a district telegraph office within a short distance of the hotel it is an unreasonable hardship to compel the company to maintain another office in the hotel itself. It was also contended that the company could not legally be compelled to maintain an office in any particular building or become tenants of a specified landlord.

Current News and Notes

A Definition of Voltage.—A sophomore in mechanical engineering at a well-known college recently contributed to science the following definition of voltage: "Voltage is the amount of force of the current, and the term volt originated from the man who discovered it, Voltaire."

* * *

Municipal Ice Plants Proposed.—The City Council of Chicago has adopted a resolution asking the Legislature of the State to confer upon cities and villages the power to erect, maintain and operate artificial-ice plants and to sell the product thus manufactured at cost to residents of the municipalities.

* * *

Wireless Experiments During Sun Eclipse.—On April 23 a partial eclipse of the sun will be observed in France, and special arrangements have been made to carry on experiments in wireless telegraphy on this occasion. It has long been noticed that the distance over which communication could be maintained varies greatly according to the time of day and the direction. Maximum distances are obtained at night. The wireless station on the Eiffel Tower will send messages continuously, commencing a short time before the coming of the eclipse and lasting until it has entirely passed.

* * *

People's Electrical Page.—The *Chicago Examiner*, Hearst's Chicago morning newspaper, has a "People's Electrical Page" in its issue dated April 8. The reading matter consists of two articles entitled respectively "Electric Light Makes Modern Home a Veritable Aladdin's Palace" and "The Electrical Age Has Arrived." Sixteen advertisements appear, the largest space being taken by the Commonwealth Edison Company. An "Electrical Page" is now being printed in dailies in seventeen cities. Denver will soon be added to the list, and it is expected that New York and Philadelphia will soon be included.

* * *

Colorado Electric Club Membership Campaign.—As chairman of the membership committee of the Colorado Electric Club, Mr. W. V. Mulvihill has arranged and carried out the following plan: The membership, about 300 in good standing, was divided into the "Blues" and the "Reds," with Mr. B. M. Wesley and Mr. T. B. Burnite the respective captains. These chose their lieutenants, assigned to them their squads, and a thirty-day competition in securing new members was started. As a result of the interest aroused the end of thirty days found 354 new members enrolled, and the Blues, who lost, owe the total membership a dinner. Every member who secured a new one obtained the club pin free, and every new member for his initiation fee of $5 and yearly dues of $1 also received the pin. The club membership is now 680, with an average attendance at the weekly luncheons of 150 and a record of 324.

Meter Tests.—Tests of 7313 electric meters were made during February, 1912, according to reports filed with the New York Public Service Commission, Second District. Of these 463, or 6.23 per cent, were fast; 5945, or 81.29 per cent, were accurate, and 905, or 12.38 per cent, were slow. The total number of companies was 238, of which thirty-five made no report. Of those that reported ninety-seven made no tests.

* * *

Regulation of Illuminating Gas.—The Bureau of Standards is soon to issue a circular entitled "State and Municipal Regulations for the Quality, Distribution and Testing of Illuminating Gas," which will contain 133 pages dealing mainly with the candle-power heating value, purity and pressure of gas and gas-meter testing. Copies may be obtained free of charge by addressing the director of the Bureau of Standards, Washington, D. C.

* * *

The Hyphen in Electrical Phraseology.—A paragrapher on the *Chicago Daily Tribune* illustrates as follows the value of the humble hyphen in making clear, on occasion, the meaning of printed words: "The new proof-reader, in the performance of his duties, came upon this sentence: 'An electrical cow milking device is to be exhibited, etc.' 'Gosh!' he muttered; 'something's wrong about this. What is an electrical cow, anyway? And how could an electrical cow milk a device? Or am I going crazy?'"

* * *

Starting Currents of Transformers.—The effect of substituting silicon-steel cores for the older types of cores in transformers, in order to permit a higher magnetic density to be employed, has been to increase both the normal exciting current and the initial current rush when the transformer is placed in circuit. The University of Illinois has issued as its Bulletin No. 55 a report of a series of tests on five transformers tending to show that the current rush has been almost doubled. The bulletin has been prepared for distribution upon application to Dean W. F. M. Goss, Urbana, Ill.

* * *

Life of Mercury Rectifier Tubes.—Some unusual examples of longevity have been observed among the rectifier tubes of the Detroit public lighting plant. A number of these tubes have exceeded 6000 hours, while recently several have recorded such runs as 6900, 7238 and 7604 hours of actual lighting duty and are still in service. These figures do not include the preliminary warming-up runs given the rectifiers at starting. The Detroit municipal lighting station is located on the river front, and the rectifiers are kept at a uniform low temperature by circulating through them the cold water from Lake Huron.

* * *

Electric Club of Chicago Votes Money for Jovians.—A joint meeting of the Electric Club of Chicago and members of the Sons of Jove was held on April 4. Mr. John R. Harmon, newly elected treasurer, reported the club's flourishing condition with 325 members and a balance of $4,261.69 in the treasury. A majority of those present were Jovians as well as members of the Electric Club, and by a vote of eighteen to eight, afterward declared unanimous, funds of the Electric Club up to $500 in amount were appropriated to defray the cost of a forthcoming Jovian rejuvenation in Chicago. As explained by one of the speakers, this unusual action was taken "to strengthen the membership of the Jovian order in the Chicago district." President A. A. Gray presided, and Messrs. A. L. Millard, J. G. Pomeroy, F. P. Vose, J. H. Delany, W. S. Taussig and O. B. Duncan spoke in favor of the motion. Owing to the small vote, there is a possibility that the matter may be reopened, as only about one-third of the members of the club are also members of the Sons of Jove.

St. Louis N. E. L. A. Section.—One hundred and twenty members attended the March 29 meeting of the Union Electric Light & Power Company Section, N. E. L. A., held in the City Club, St. Louis. Mr. W. S. Parker, engineer in charge of the Ashley Street plant, read a paper on "Modern Power-Plant Operation," outlining in detail the processes of converting fuel into electrical energy. Economic burning of fuel, he said, is of the greatest importance to central-station efficiency, since the fuel constitutes 40 to 50 per cent of the cost of the energy developed. Touching on the interesting development of the steam turbine, he declared that from the operating standpoint the turbine so far surpasses the reciprocating engine that there is absolutely no comparison. Mr. Parker also emphasized the fact that in the end the personal factor invariably forms the main feature in successful power-plant operation. In discussing the paper Mr. E. H. Tenney illustrated the work done in the testing laboratory of the plant, describing methods of making fuel analyses and boiler and turbine efficiency tests. Mr. Eugene Stephens, of the General Electric Company, also spoke of the manufacturing methods and applications of the graphitized-filament lamp.

* * *

The Complexion Room.—As described in the *Electrical World* of Nov. 25, 1911, page 1309, the handsomely decorated restaurant in the Congress Hotel, Chicago, known as the Louis XVI room, is lighted in a very interesting and effective manner by the use of light pedestals arising from the floor supporting large shallow urns, each containing four 400-watt tungsten lamps equipped with mirror reflectors. The light from these lamps is thrown on the cream-white ceiling and thence reflected to all parts of the room. Inasmuch as the pedestals and urns are beautified with flowers and plants and are apparently simply a part of the decorative scheme of the room, it is difficult for a visitor to determine where the light comes from unless he has been informed. The great volume of light and its very general diffusion, without shadows, makes the artificial lighting a close substitute for daylight. It is, however, softer than direct daylight, and makes a very pleasing illumination. One interesting feature is that the light is very benignant in showing to greater advantage the animated countenances and brilliant costumes of the ladies, with whom it is popular. Hence this room is known among the attachés of the hotel as the "complexion room."

* * *

SOCIETY MEETINGS.

Worcester Branch, A. I. E. E.—At a meeting of the Worcester Polytechnic Institute Branch of the American Institute of Electrical Engineers held on April 12 Mr. H. J. W. Fay, of the Submarine Signal Company, Boston, presented a paper entitled "History and Development of Submarine Signaling."

* * *

American Institute of Consulting Engineers.—A meeting of the American Institute of Consulting Engineers for the purpose of discussing the question of "Engineer Commissioners" will be held at the Engineers' Club, 32 West Fortieth Street, New York, on Wednesday evening, April 17, 1912, at 6:30 p. m. It is the intention to have this a dinner meeting.

* * *

Nebraska Electrical Association.—The annual convention of the Nebraska Electrical Association, which is affiliated with the National Electric Light Association, will be held at the Loyal Hotel, in Omaha, on April 16, 17 and 18. Mr. H. A. Holdredge, of Omaha, is the president of the association, and Mr. S. J. Bell, of David City, Neb., is secretary-treasurer.

HIGHEST-VOLTAGE TRANSMISSION SYSTEM IN THE WORLD.

Plant of the Au Sable Electric Company, Supplying Electricity to Bay City, Saginaw and Flint, Mich.

Special 140,000-Volt Oil Switches, Lightning Arresters and Transformers. Details of Line Construction and Wall Inlets—Operating Characteristics and Provisions for Tests.

ANOTHER long stride in the advance of transmission potentials is marked by the use of 140,000 volts pressure on the Au Sable Electric Company's newly built 235-mile system connecting its Au Sable River water-power sites with Bay City, Saginaw, Flint and, later, Owosso, Lansing and Battle Creek. The present 125 miles of 140,000-volt line has already been in successful and uneventful service more than a month, and on test has been carried to a potential of 145,000 volts as measured at the power house, with a corresponding pressure at the sub-station end of 170,000 volts, due to the condensive reactance of the long line. The conductors are supported on suspension insulators composed of ten 10-in. disks, each disk tested to withstand 80,000 volts continuously or 125,000 volts momentarily, and all high-tension insulation and clearance are designed with a wide margin of safety beyond the normal 140,000-volt operating potential. Special designs of standard high-voltage equipment were required to fulfil the 140,000-volt conditions for oil switches, lightning arresters and transformers. The three last-mentioned units have their high-tension windings delta-connected, imposing the full 140,000-volt pressure across the coils, and in several cases transform down, in a single step, to minor 370-volt secondaries, a ratio of nearly 400 to 1.

Over the 140,000-volt line, hydroelectric energy from the 9000-kw Cooke plant, developing a 40-ft. head on the Au Sable River in the wilds of Iosco County, is now being transmitted 85 miles to the Zilwaukee substation, which supplies Bay City and Saginaw, and 40 miles further to Flint, where with a steam-turbine auxiliary a large industrial load is served. The Cook development is but the first of several water-power sites on the Au Sable River, whose output will be delivered over the new transmission line. A second site at Five Channels, 8 miles above Cooke, is now under development and will be operating before the close of the year. By June the 140,000-volt transmission will be in use as far as Owosso and Lansing, later tying in to the associated transmission systems at Battle Creek, a distance of approximately 250 miles from the power site on the Au Sable River.

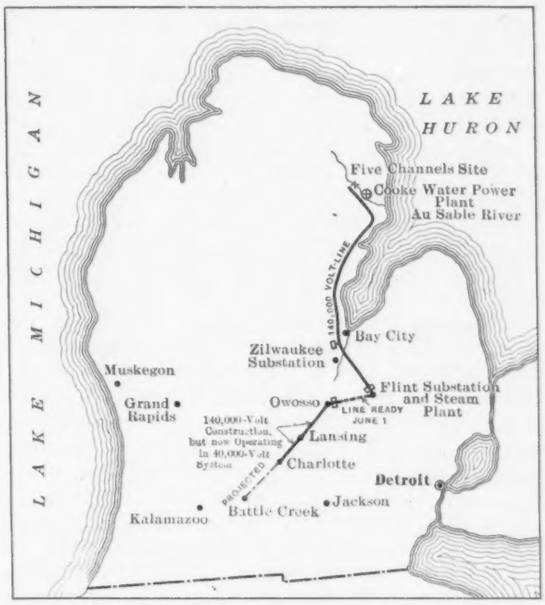


Fig. 2—Map of 140,000-Volt Transmission Line.

This present 140,000-volt achievement, the reader should be reminded, is but the culmination of a series of pioneering advances in high-tension transmission made under the same direction, in the course of which the Michigan systems identified with the Commonwealth Power Company, of Jackson, have been the scene, successively, of the first 72,000-volt, 110,000-volt and now 140,000-volt line ever built or operated.

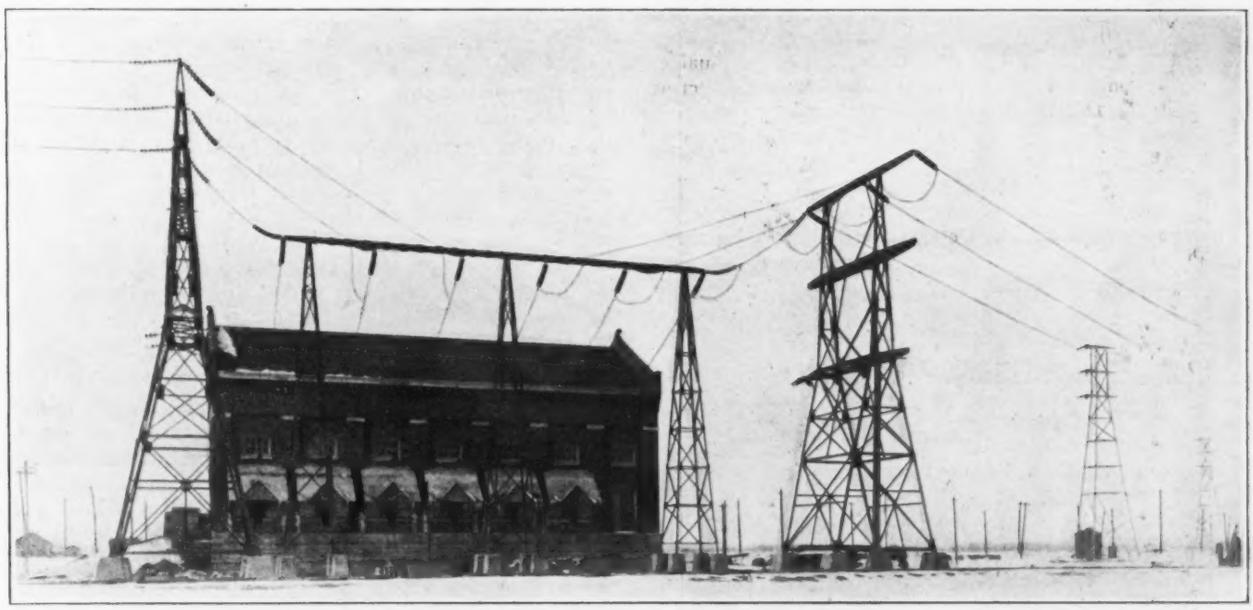


Fig. 1—140,000-Volt Entry Towers and Substation at Zilwaukee.

AU SABLE RIVER AND COOKE PLANT.

Unusual uniformity of flow marks the Au Sable River, the run-off of which at flood has rarely reached more than

three times its minimum flow, 1100 cu. ft. per second, as shown by the records of ten years. Springs emerging from the clay strata which underlie the sandy surface of this part of the peninsula are believed to account for this regularity of flow, for the stream is fed by but two insignificant tributaries of a few second-feet each in its whole length of 60 miles from the power sites to the confluence of the three streams which form the main river.

The Cooke plant is located about 16 miles from the mouth of the Au Sable, and at approximately the same distance from the nearest towns, Au Sable and Tawas City. It is a dozen miles from any human habitation and can be reached only by driving 18 miles across country, or by a narrow-gage logging railroad from Au Sable. The development comprises a 40-ft. concrete dam and power house and concrete-core wall inclosed in earth embankment, creating a pond 2000 acres in area and making available a head of 40 ft.

The power house measures 67 ft. by 116 ft., with massive concrete foundations and molded water passages, the upper building walls being of red brick with truss-supported roof. Between the power house and the spillway section is a 6-ft. log sluice. A free spillway length of 72 ft. is provided by three 24-ft. by 13-ft. Tainter gates, which will be operated by a 7½-hp motor controlled from the gatehouse above.

The same Tainter construction is also applied to the 20-ft. by 25-ft. headgates which admit water to the turbine chambers, as shown in an accompanying illustration. This use of Tainter gates for penstock control is probably the first application of its kind in American hydraulic design, although the idea has been used abroad. Later it is planned to control these gates from the switchboard so that the amount of gate opening will be under the hand of the operator.

The hydroelectric equipment comprises three 4150-hp

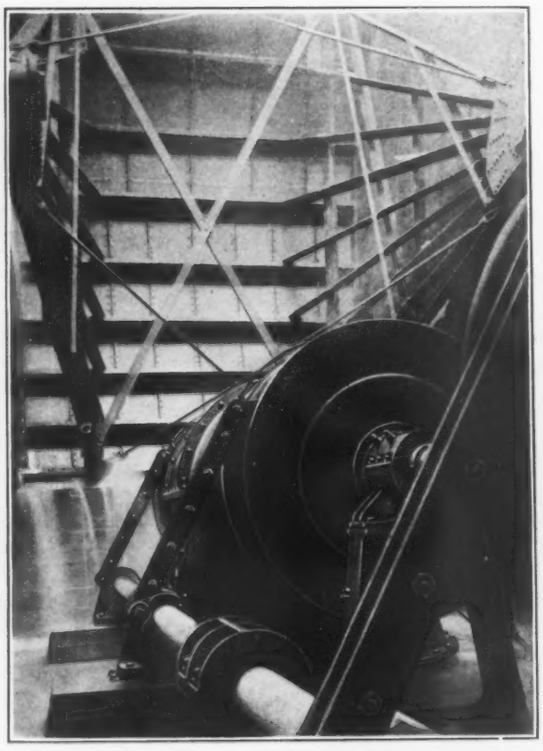


Fig. 3—Tainter Headgate and Interior of Turbine Chamber.

Allis-Chalmers four-runner water turbines driving 3000-kw General Electric 2500-volt, 60-cycle, three-phase alternators at 180 r.p.m. The waterwheels are controlled by Allis-Chalmers oil-pressure governors of a newly improved type, driven through double belts and having their fly-ball settings adjustable from the switchboard. Each main generator has its individual 32-kw interpole 125-volt exciter mounted on its shafts, all three exciters being connected to a common direct-current bus. A grease gun provides forced lubrication to eight bearing points on each water turbine.

In the south end of the generator room are grouped the 140,000-volt transformers and oil switches. The station

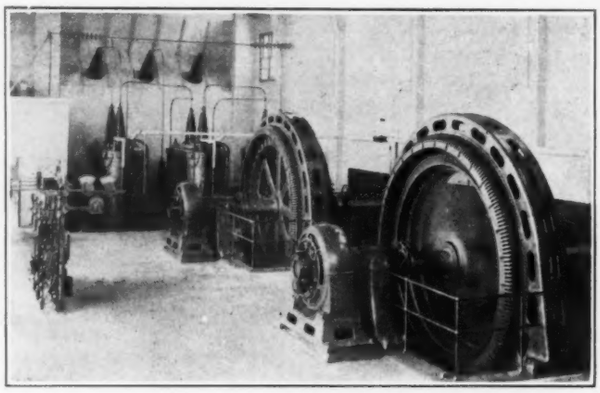


Fig. 4—Generators and 140,000-Volt Exit at Cooke Plant.

switchboard is mounted opposite the middle generator, all connections and auxiliary equipment being located in the basement. Inclosed in conduit the 2500-volt generator leads are brought up to the General Electric K-12 15,000-volt type oil switches, which connect to the station bus through hook switches. A 2500-volt aluminum-cell lightning arrester protects the station bus. This 2500-volt bus is thence extended directly to the delta-connected transformer primaries, through air-break disconnect switches mounted on the transformer cases.

The switchboard at Cooke comprises three generator panels and one regulator panel. The latter carries a twelve-section Tirrill regulator, which is supplemented by an excess-voltage relay, designed to reduce the generator pressure in case the voltage passes beyond the control of the Tirrill regulator. Besides the standard complement of switchboard instruments, there are a synchroscope, a frequency indicator, a curve-drawing wattmeter and a recording frequency meter. The last mentioned, built by the Lombard Governor Company, comprises a small synchronous motor driving a fly-ball governor, the amplitude of whose arms is recorded, through a sliding collar, by a stylus marking on a clock-driven paper ribbon. The generator oil switches are operated from switchboard levers and are equipped with time-limit relays set to open in five seconds at 1200 amp, the tripping coils being energized from the direct-current bus. Series and shunt instrument transformers, field rheostats and the station-service transformers are all mounted in the basement bus compartment.

140,000-VOLT TRANSFORMERS.

Three 3000-kw General Electric oil-insulated water-cooled transformers step the generator pressure, 2500 volts, up to the 140,000-volt transmission potential, both low-tension and high-tension windings being delta-connected. These huge transforming units measure 11 ft. by 5 ft. in section and 14 ft. 6 in. to the top of their cases, or 19 ft. 6 in. to the tips of the high-tension terminals. When shipped the tanks had to be laid obliquely in gondola cars to meet the railroad clearances. Each tank weighs 17,000 lb. and its core 34,000 lb., making the total weight per transformer, filled with oil, nearly 43 tons. The composition-filled 140,000-volt terminals measure 4 ft. in height and taper in diameter from 20 in. to 10 in., being fitted with twenty 3-in. pressboard leakage rings to increase the surface path between conductor and case. A center distance of 5 ft. is provided between terminals on the transformers, and this minimum distance between 140,000-volt conductors and ground is preserved everywhere about the high-tension structures,

except for the oil-switch terminals, which are separated only 4 ft. The transformers are themselves installed at center distances of 11 ft. Before shipment a factory test of 280,000 volts, or double rated pressure, was given these units.

Ordinary ¾-in. iron pipe is used for the 140,000-volt

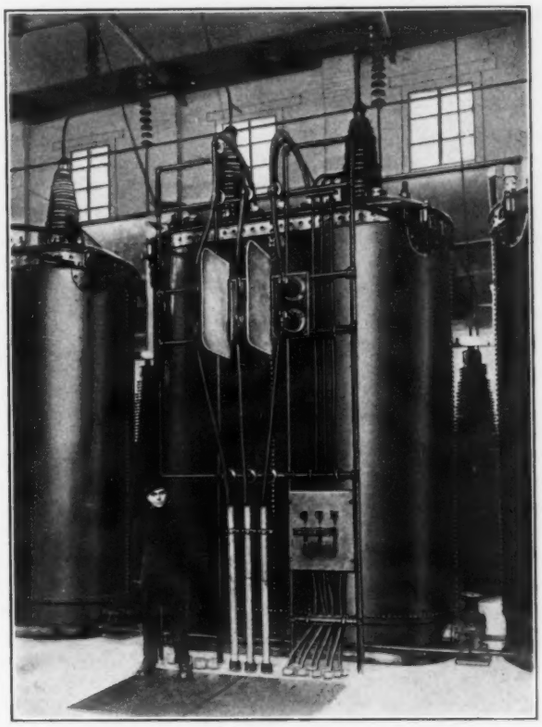


Fig. 5—3000-kw, 140,000/22,000/370-Volt Transformer.

buses and connections, all high-potential parts being either supported on the transformer oil switch or entry insulators or suspended from regular 10-disk line insulators. All turns are made by bending the pipe, and for exposed joints couplings are used cut with extra threads for backing out one side so that the conductors can be dismantled without the use of unions, whose sharp points would give rise to corona effects. Where the use of unions has been necessary, and also where taps are made to the overhead buses or these are supported by the insulator hangers, hollow brass balls inclose the irregular and sharp points of the fittings, eliminating corona discharges. A minimum clearance distance of 5 ft. between conductors and ground has been preserved in all high-tension construction, although much wider spacing is used wherever possible.

Behind the transformers in the Cooke power house are installed the 140,000-volt General Electric K-10 oil switches, designed to break 100 amp per phase, the full-load current of the 9000-kw transformer group being, however, but 21.4 amp. The oil-switch tanks measure 8 ft. by 4 ft. in plan and 12 ft. to the top of the terminals, which are generally similar to those on the transformers. One of the stationary contact elements and terminals is shown in Fig. 7, the circuit being completed between two such contacts by a lower moving bridge element, which has an 18-in. travel and thus in its open position interposes a double break totaling 36 in. of oil path between the terminals. These oil switches are hand-operated and wholly non-automatic, being controlled from a hand lever in the high-tension pit. They have been tested by actually rupturing pressures up to 500,000 volts and are believed to be capable of breaking any current which may occur in the line.

Both switch and transformer tanks can be drained of their oil by 6-in. pipe lines discharging into a pair of steel tanks with a combined capacity of 9000 gal., equal to that of one transformer tank. A motor-driven pump is provided for returning the oil to the apparatus tanks after repairs have been made. Provision is also made for continuous sampling and filtration of the oil in any transformer without removing the unit from service. Through taps at the top and bottom of the transformer case the oil is withdrawn and filtered by forcing it, at 200-lb. pressure, through a series of thirty filter sections, each containing five 8-in. by 8-in. filter papers, making a total thickness of about 0.75 in. of paper. The paper filters the oil and removes all moisture, returning it to the case dry and clean. With the filter equipment provided for each tank of 140,000-volt transformers, 300 gal. of oil can be filtered per hour. In starting up the transformers, the entire contents of each tank were passed through the filter three times. The oil will be filtered again as needed, when its moisture tests show the need of further drying out. All circulation water lines for the 140,000-volt transformers are heavily lagged with a 1-in. asbestos covering on both the entry and discharge sides. No special provision is made for grounding the transformer and switch tanks except through the usual oil-pipe and water-pipe connections.

HIGH-TENSION WALL INLETS AND LIGHTNING ARRESTERS.

Much interest attaches to the method of bringing the 140,000-volt conductors out through the walls of the building. In all cases on the Au Sable line these inlets are entirely closed and weatherproof, the construction being best explained by the illustrations, showing the entry insulators placed at 11-ft. centers. The entry insulators used for the indoor portions are similar to the filled terminals on the 140,000-volt apparatus, while for the outdoor sections a 6-ft. petticoated porcelain type is employed corresponding to those on the outdoor lightning arresters. From tip to tip these entry insulators thus measure 10 ft., 6 ft. of which is outside. The entry insulators are seated in iron ring cast-

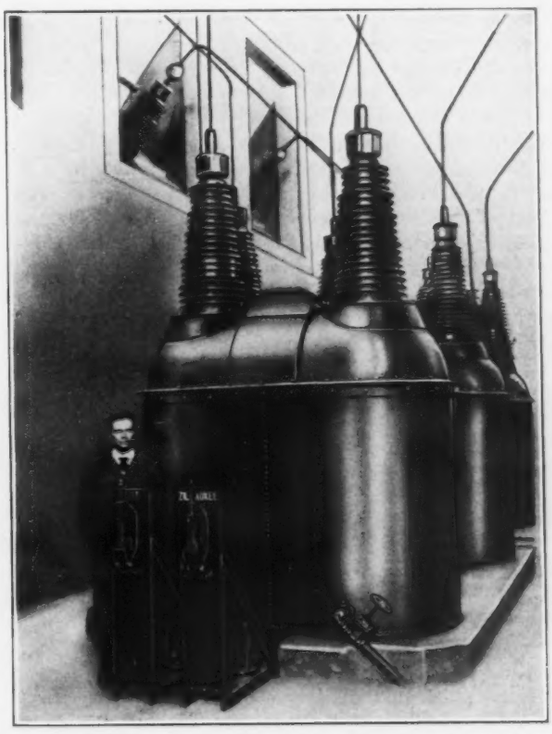


Fig. 6—140,000-Volt Oil Switches in Zilwaukee Substation.

ings supported on the 45-deg. angle framing, the middle panels being of sheet metal made removable so that the entry insulator can be slipped out of place if desired. The other parts of the entry boxes are of plastered "Hy-Rib," supported on steel framing. A 3-ft. gable protects each line wire from the roof drippings. The entry box steel work

is not specially grounded, except through the natural moisture in the brick wall. The entry wall openings measure 9 ft. by 11 ft., with 9-ft., 45-deg. canopy roofs, and are placed at 11-ft. center distances.

Connection between the entry jumpers and the dead-ended line wires is made through removable clip contacts,

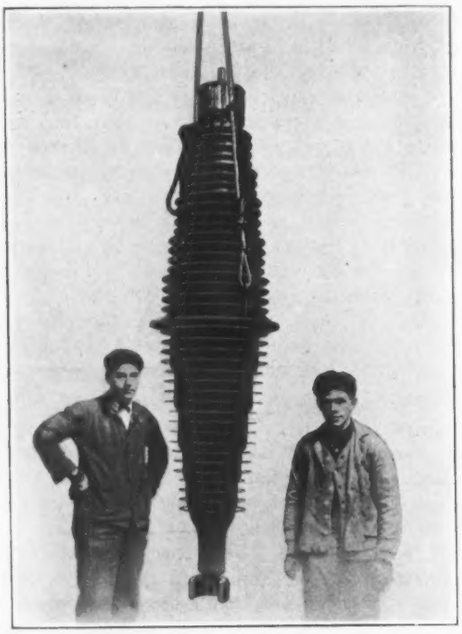


Fig. 7—Terminal Bushing and Contact of 140,000-Volt Oil Switch.

which can be disconnected in case of emergency. These special contact clips are provided with funnels to guide into place the threaded caps of 18-ft. treated hard-maple sticks. After screwing the pole end into position a further twist opens the contact springs and releases the clip. This disconnect feature is intended only as an emergency expedient to be used to isolate the station apparatus while the potential is off the line, but as it is now designed it is believed that the full 140,000-volt pressure might be interrupted in this way, using a grounded stick, without danger to the operator.

Tapped into the line wires just outside the entry jumpers will be the connections for the 140,000-volt General Electric outdoor aluminum-cell lightning arresters. These huge units have been delivered to the system, but in the haste of starting up the line have not been installed during the winter months. Each tank measures 6 ft. by 3 ft. and is arranged with 9-ft. porcelain line terminals and 6-ft. center terminals.

TOWER-LINE CONSTRUCTION.

The transmission conductors are of No. 0 medium hard-drawn stranded copper cable, made up of seven No. 8 wires drawn upon specifications of the power company by the American Brass Company. At 140,000 volts the line wires, ⅜ in. in diameter, are practically without a visible corona or brush discharge, except during unusual atmospheric conditions when a slight discharge can sometimes be noticed on a dark night. The charged conductors do, however, produce a readily audible buzz or hum that can be heard for several hundred feet.

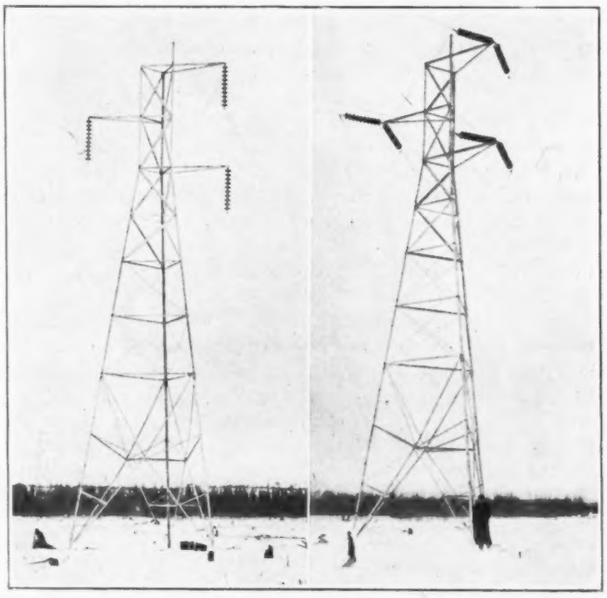
Tripod steel galvanized towers measuring 40 ft., 50 ft. and 60 ft. to the lowest conductors, built by the Aermotor Company, are erected at intervals of 500 ft., 865 towers being used in the transmission from Cooke to Zilwaukee and 420 towers from Zilwaukee to Flint. These towers are foundationed on 3-in. by 3-in. by 3/16-in. steel anchors spaced by means of a template, and are raised and bolted into place after being assembled at the site. The standard "40-ft." tower, measuring 54 ft. over all, which is used under ordinary conditions, has 3-in. by 3-in. by 3/16-in. angle steel legs, and 3-in. by 3-in. by ⅛-in. angle cross-arms, each arm being braced by a ⅝-in. round rod.

Each string of ten 10-in. disk insulators measures 5 ft. 3 in. from mast-arm to conductor. These insulators, made by the Ohio Brass Company, are designed to stand a continuous potential of 80,000 volts per disk and have been subjected to a momentary "kick test" of 125,000 volts per disk. On the tower line the three conductors form a triangle with sides respectively 17 ft. 4 in., 17 ft. 4 in. and 12 ft., the last being the vertical distance between the two conductors on the same side of the tower. The conductors were strung with the aid of a dynamometer, being pulled up to a tension of 1200 lb. each, allowing for approximately a 12-ft. sag in the 500-ft. spans.

On tangent stretches simple suspension construction is used, but wherever the line turns through more than a few degrees the strain-type construction illustrated in Fig. 9 is employed. In this case the same type of 10-disk insulator is used, the spans being dead-ended in special side-pass clamps supported by the insulators and the conductor then extended to the opposite strain insulator on the same arm, forming a 12-ft. loop which must clear the arm and all grounded parts of the tower by at least 6 ft.

The 140,000-volt, ten-disk insulator line is now completed from the Five Channels site past Cooke to Flint and the line from Flint to Owosso is nearing readiness for operation. The 50-mile line from Owosso to Charlotte was erected two years ago, using eight disks per insulator, and is now operating at 40,000 volts awaiting the delivery of Au Sable water-power. The ten-disk insulators will be added before 140,000-volt operation begins.

Various different heights of towers have been used to conform to the contour of the country through which the line passes. In one place an earth bank had to be excavated to clear the wires on a special span. Two 167-ft. steel towers (Fig. 13) support the 600-ft. span across the Saginaw River near the Zilwaukee substation. These towers also carry the 11,000-volt and 22,000-volt lines from the Zilwaukee substation into Saginaw, the minimum span height being 135 ft. The erection of the structures in-



Figs. 8 and 9—Standard Tower and Corner Tower Respectively.

cluded the solution of an unusual foundation problem, for the ground at this point is made from the slab and log refuse of years of sawmill operation. After cutting through many feet of this material a firm footing was finally reached.

Other features of this transmission system will be described in a following issue.

NETWORK OF ELECTRICAL CONDUCTORS.

Principles of and Simple Methods for Designing and Calculating Network Distribution Systems.

BY FRANCIS B. CROCKER.

THE most complete system of parallel distribution is that in which the conductors are interconnected to form a network. This arrangement was developed from the "feeder and main" method of Edison and is also due to him. It is used in many large cities throughout the world for low-tension, direct-current distribution at 100-500 volts, and is often employed for the secondary circuits of alternating-current transformers, especially where the system is large or important. The enormous networks of mains constructed by the Edison companies in New York, Chicago, Philadelphia, Brooklyn, Boston and other large cities may be cited as very prominent examples. Networks are sometimes adopted in the interior wiring of buildings, but they are usually of a simple nature in cases of this kind.

A two-wire network of conductors in indicated in Fig. 1, *A B C D* being composed of two sets of positive mains at right angles to each other and connected at the points where they intersect, *E F G H* being a similar network of negative mains represented by dotted lines. The mains are supplied with energy from the generating station *S* by feeders (not shown because they would confuse the diagram). At any desired point a lamp will be fed with energy if connected between the + and — networks. In fact, the case may be considered as equivalent to that in which two parallel sheets of copper netting are respectively connected to the two terminals of a source of electrical energy, and the lamps are supplied with energy by connecting them across from one sheet to the other.

Advantages of a Network.—The two great advantages secured by employing a network of conductors for the distribution of electrical energy are avoidance of interruption of service, because there are many paths for the current to almost any point, all of which are not likely to be impassable simultaneously, and uniformity of voltage, also resulting from the numerous current routes throughout the system.

General Distribution of Current and Voltage in Networks.—In order to study the flow of current in a simple manner let us consider by itself one-quarter of the positive network, and suppose it to be supplied at the point *J* by a feeder from the station *S*, as represented in Fig. 2. As-

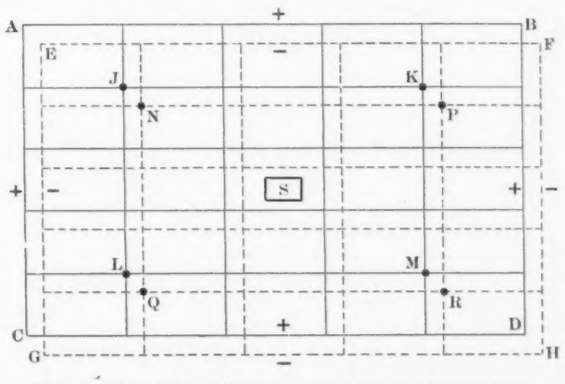


Fig. 1—Two-Wire Network for Parallel Distribution.

suming that those portions of the three horizontal and the three vertical mains included between the points *A, Y, X* and *Z* are uniformly loaded, and not considering the effect of any load outside of this region, it follows that one-quarter of the current will flow out from the feeding point *J* on each of the four mains leading therefrom. With ten lamps, each taking 1 amp connected to each of the twelve sections of the mains, the initial current in the main *J a* is 30 amp, because three sections (*J a, a A* and *a Y*) are supplied by it. When the current reaches the point *a* it is reduced to 20 amp, 10 amp being consumed in the section *J a*. Hence the average current between *J*

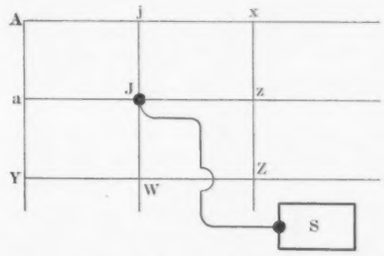


Fig. 2—Portion of Network Represented in Fig. 1.

and *a* is 25 amp; and, assuming the resistance of each section to be 0.4 ohm, the drop in *J a* is 1 volt. The initial current from *a* to *A* is 10 amp, and its final value is zero; the average being 5 amp with a drop of 0.2 volt for that portion. The same is true of the section *a Y*, provided the load beyond Y be ignored, as already stated. Having thus determined the drop in voltage on the positive mains, it is evident that precisely the same drop will also occur on the corresponding negative conductors. A lamp at *J* receives the full pressure supplied by the feeder, assumed to be 112 volts; a lamp at *a* receives $112 - (1 + 1) = 110$ volts, and a lamp at *A* $112 - (1 + 1 + 0.2 + 0.2) = 109.6$ volts. Similar statements apply to the lamps at the other points, *W, Z*, etc.

The other three-quarters of the network, fed respectively at *K, L* and *M*, would have corresponding currents and voltages for a similar amount and distribution of load. This preliminary discussion does not consider the sections immediately to the right of *x, y* and *z* or immediately below *Y, W* and *Z*. Lamps connected to them would increase the current somewhat in those mains between the said sections and the feeding points, but the additional drop would be small.

When the lamps are not uniformly distributed the problem is much more difficult to solve. In the apparently simple case of a single lamp connected at *W* the greater part of its current flows directly from *J* to *W*, but a considerable fraction will take the path *J a Y W*, and also the path *J z Z W*. In fact, a small amount of current will take the course *J j A Y W;* and if the network were extended beyond *A*, some current would follow still more indirect routes. Current would also pass through the remainder of the network shown in Fig. 1, as well as through the remainder of the portion represented in Fig. 2; indeed, a single lamp connected at any point of a network causes current to flow in every section except a few that might happen to have no potential difference between their ends. With a number of lamps irregularly located, the conditions become even more complex.

It might be supposed that the problem could be solved simply by comparing the resistances of the various paths. For example, the course *J a Y W* has three times the resistance of *J W*, hence the current in the former should be one-third as much as in the latter. This is not true, however, because *J j A a* is in parallel with *J a*. If an attempt be made to allow for this by calculating the joint resistance, the case is further complicated by the fact that the section *J j* carries current that flows by way of *X* as well as through *A*, and so on. Various exact or approximate methods for solving network problems will be given later in the present article.

Electrical Model of Network.—In the pioneer work of Edison in 1882 the design of the underground network of conductors was aided by constructing models in which the

conductors were represented in miniature by copper wires. With a model correct in scale it is possible to determine empirically the distribution of current and drop with various amounts and positions of load. This method would ordinarily be considered too troublesome, although it might often effect a considerable saving in, or better arrangement of, the copper. The results due to any change in loads, size of conductors, feeding points, etc., could be quickly determined in an unmistakable way by actual tests of such a model. To arrive at the same facts analytically is likely to involve laborious calculations even for a slight alteration of conditions.

Mechanical Model of Network.—Another method of solving this problem devised by Mr. H. Helberger,[1] of Munich, consists in employing a mechanical model in which the mains are represented in length and location by horizontal strings stretched with a certain force corresponding to the cross-section of the conductor, the load being applied in the form of weights that are hung upon the strings and are proportional to the current consumed at the various points. The amount that the strings are depressed indicates the drop in voltage, being usually limited to a certain value in a given case. The points at which the strings are supported correspond to the feeding points, being raised or lowered with respect to each other a distance proportional to any difference in the voltages with which they are fed.

Practical Design of Networks.—Exact methods, whether analytical or empirical, for determining the size of the mains in a network are not much used in America or in England, although they are generally applied in Germany. It has been common practice to employ a few standard sizes of mains. For example, each of the three-wire mains may have a cross-section of 350,000 circ. mils in the central and heavily loaded portions of the network and a cross-section of 200,000 circ. mils in the outlying or less heavily loaded districts, and in some cases conductors of 150,000 circ. mils may be large enough. It has not usually been considered necessary to determine the size of each individual main or section thereof, the same size being used throughout a large district, having been selected with reference to general rather than local conditions.

The justification for this apparently crude practice is, first, the simplicity of laying and maintaining a network composed of only two or three standard sizes of mains, larger or smaller sizes being either too clumsy or too weak mechanically; second, it is practically impossible to predetermine the current that a main will carry, the demand upon it being often much greater or less than that expected; third, an excess of copper in one portion of a network tends to help other portions that are more heavily loaded, and conversely a small section of a main acts as a weak link in the chain. Hence it is usually unwise to attempt to save copper in a particular part just because the load expected upon it may be less than in the surrounding mains, especially as this assumed condition may not prove to be a fact.

It is important to appreciate the co-operation of all portions of a network of conductors, as it constitutes its chief advantage. In the mechanical model already cited it is evident that all of the strings aid each other more or less in supporting a weight hung at any point upon them. The electrical analogue acts in similar manner. On the other hand, it is an indication of bad engineering to select arbitrary sizes for the parts of a structure or system. Such a rule-of-thumb procedure usually means that excess of material is required because there is a deficiency of knowledge. An ignorant man might build a safe bridge by using ten times as much steel as that really needed. The engineer's principal function is to insure good results with minimum material. An electrical network is very different, however, from a bridge or almost any other construction, because surplus material in any part always helps and never weakens it. Provision must also be made for the fact that the circuit through one or more of the mains may be broken, also that uniformity is the chief object of such an arrangement of conductors and should not be interfered with merely to make a local saving in copper that would be only a small fraction of the whole. Nevertheless, rational methods are also preferable to empirical ones and may be successfully applied in this case. Therefore various analytical processes will here be given for the solution of problems relating to networks in order to design or investigate them.

[1]German patent No. 68,918, April 5, 1892. Also *Western Electrician*, April 27, 1897.

EXACT SOLUTION OF NETWORK PROBLEMS.

The distribution of current, voltage drop and size of conductors in a network may be determined accurately by applying Kirchhoff's laws, which are as follows:

1. The algebraic sum of the currents in all the conductors that meet at any point is zero.

2. The algebraic sum of all the products of the currents and resistances in conductors forming a closed loop equals the algebraic sum of all the emfs in the loop.

In networks of distributing mains there is usually no emfs working within each loop, as, for example, the loop *J a Y W*, the emf being confined to feeders. Therefore the second law may be simplified as follows:

The algebraic sum of all the products of the currents and resistances in conductors forming a closed loop is zero.

The application of these principles to simple cases is easy, but to apply them to the extensive and complicated networks used in practice is somewhat difficult, particularly when the lamps are unequally distributed. Methods for making such calculations given by Herzog and Stark,[2] Herzog,[3] Coltri,[4] Muellendorff[5] and others will now be explained.

The principle of the superposition of currents, which is also very useful in studying networks, may be stated thus:

When two or more currents are led into and out of a conductor at various points, the resultant current in any particular section equals the algebraic sum of the component currents considered separately. To apply this principle the path and strength of each current is determined by Ohm's law just as if the others did not exist. Then by combining the separate currents that flow through any given part of the conductor the resultant or actual current there is found.

For two-wire circuits of any kind, including networks, one may consider the resistance and the voltage drop for the positive conductors only and then double the values finally obtained, thus including the effect of the negative conductors. The currents and their distribution are the same, of course, for both positive and negative conductors. In the case of three-wire systems the neutral conductors may be assumed to have zero potential and the calculations be based on only the positive network with its actual resistances, voltages and currents, the results obtained being correct without doubling any of them. When such a system is approximately balanced, as usual in good practice, the conditions for the negative network correspond very closely to those found for the positive conductors. For a three-wire system that is greatly out of balance separated determinations are required for the positive and the negative networks; in fact, the resistances of and the voltage drops in the neutral conductors must also be included and the computations become exceedingly complicated. Fortunately it is rarely necessary to consider this condition,

[2]*Elektrotechnische Zeitschrift*, 1890, p. 221, and *Electrical World*, Vol. XV, p. 300.

[3]*Elektrotechnische Zeitschrift*, 1893, p. 10.

[4]*Elektrotechnische Zeitschrift*, 1893, p. 425.

[5]*Elektrotechnische Zeitschrift*, 1894, pp. 67 and 236.

which may be allowed for simply by increasing the calculated drop by a certain percentage in each case.

In textbooks networks are often treated on the assumption that current flows into them at one point and out at another, as in a Wheatstone bridge, for example. This is not the condition usually existing in electrical distribution because current flows not only through the mains, but

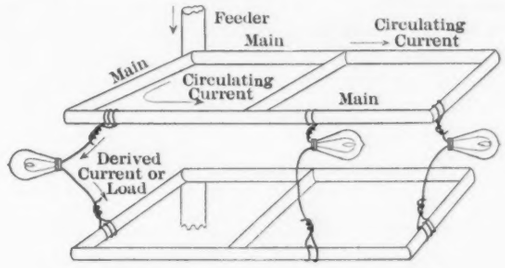


Fig. 3—Circulating and Derived Currents.

also away from the mains to the lamps, motors, etc., connected to them. Of course the lamps may be regarded as additional paths for the current similar to those through the network itself. This involves, however, the consideration of lamp resistances and resistances equivalent to motors of certain rating, which is not customary or convenient. The values of current consumed by lamps, motors, heating devices, etc., are what the engineer bases such calculations upon. Moreover, it is desirable to distinguish between the currents that flow along the mains which are called circulating currents and those flowing away from the mains through lamps, etc., called delivered or derived currents, or loads, as shown in Fig. 3. The distinction between a feeder and a main is the fact that only circulating currents flow in the former while the latter carries or supplies both kinds. When there are no lamps or other devices connected to a certain main or portion of a main then of course there is no derived current, but it may or may not act to convey or "circulate" current to other mains or parts thereof. On the other hand, it is often convenient in studying networks to consider both kinds together, that is a current that "circulates" to another main is treated the same as if it were "derived" to supply a load. These general facts are true of all systems of parallel distribution, but it is particularly important to have them clearly in mind when studying electrical networks.

The article is to be continued in a following issue.

THE THREE-WIRE DIRECT-CURRENT GENERATOR.

By William G. Merowitz.

MUCH has been written in the past on the two-wire direct-current generator, but text matter on the principles of three-wire operation with one machine has been sparingly published in the electrical periodicals during the past few years. Textbooks, too, contain very little on this subject. The three-wire system of distribution for low-voltage direct current has come into extensive use for lighting and motor service, principally because of the economical item of transmission copper which it involves.

Before the present three-wire generator was invented the original three-wire system consisted of two main generators connected in series, each wound for the voltage of the apparatus consuming the energy, a neutral wire running out from the connection between the two machines, as shown in Fig. 1. When such a system is used both machines must operate continuously. An improvement on this arrangement was made by using a main two-wire generator wound for the line voltage and a motor-generator set, connected in series across the line, as shown in Fig. 2. The motor-generator or balancing set consisted of two small machines, which were similar in their construction, and the neutral wire was led out from between them. The small machine on the side having the lighter load and higher voltage operates as a motor and drives the other machine as a generator to supply the energy for the heavier load on the other side, and thereby balances the voltages on the system automatically.

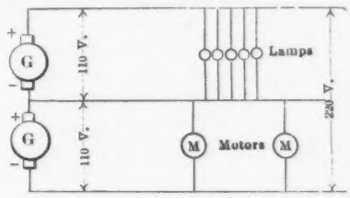


Fig. 1—Three-Wire System.

Both of the above methods possess disadvantages and cannot be favorably compared with the inherent advantages of the single three-wire generator, which will be described below. The objections to these methods are the greater initial cost and operating expense of two machines and the larger floor area required in the power plant. Moreover, there are double the number of parts requiring attention and maintenance, and the system as a whole is not as efficient as the present one, using the single generator.

The decided advantages of a self-contained machine for operating three-wire systems have encouraged many manufacturers of direct-current units in large sizes to develop such machines.

This single-machine three-wire system can be arranged without change in the machine structure of the ordinary direct-current two-wire generator. The system retains the special features of the three-wire system, with the additional advantage that only one machine is required. The energy is distributed at double the voltage of the lamps or apparatus in circuit, and the neutral wire carries only the unbalanced current corresponding to the difference in the loads on the side circuits of the system. The distribution of the energy at twice the potential of the consuming apparatus effects a saving of nearly two-thirds in the cost of copper over that of the two-wire system. The half voltage obtained from either side of the system is often convenient for variable-speed motor operation.

Fig. 3 shows one method for obtaining the three-wire system with a single machine. It will be observed that two transformers or balancing coils are connected across the two-phase collector rings, which resemble those employed on the alternating-current side of rotary-converter armatures.

The connections from the armature to the rings may be either single-phase, two-phase or three-phase, but the two-phase connection is usually employed on account of the better characteristics obtained.

The auto-transformer balancing coil is simply a single winding upon a laminated iron core. The middle points of the two coils are connected to the neutral wire as shown in Fig. 3. The coils are placed in iron cases, filled with oil, in a manner similar to standard oil-cooled transformer construction, and these cases are located near the generator in a convenient place about the engine-room.

Another method for obtaining the three-wire system with a single armature is shown in Fig. 4. Here the balance coil is connected to two points of the armature winding similar to a single-phase rotary-converter connection. The neutral wire is then taken from the middle point of this coil and carries only the unbalanced current. The companies that use this method mount the balance coil on the generator itself, so that the whole equipment is self-

contained. Only one collector ring for the neutral wire is necessary, and the auto-transformer is not set in a case of oil.

Two balance coils, shown in Fig. 3, give better results than does the arrangement of Fig. 4. The latter method has produced a pulsating voltage in some constructions, which caused lamps on its circuit to flicker.

The following explanation will show that the middle point of the balance coils is the neutral point and therefore is the theoretically correct connecting point for the middle wire. In Fig. 5 is shown the armature winding of a two-pole machine, used for explanation because it is simpler to understand. Points *A* and *B* represent the permanent connections of the balance coil, which is symmetrically placed on the armature winding. The generator brushes are shown at *C* and *D* and the neutral wire is connected at *F*, which is the middle point of the balance coil. Now, when point *B* is directly under *C* and when *A* is directly under *D* the full generator voltage is impressed upon the balance coil between the points *F* and *C* and *F* and *D*. That is, the voltage on the balance coil from *F* to *B* and *F* to *A*, when the terminals are under the brushes, is equal to one-half that between *C* and *D*. If the armature is now rotated so that the points *A* and *B* are directly under the poles, as shown in Fig. 5, the balance coil is subjected to no difference of potential and the voltage between *F* and *C* and *F* and *D* are equal to those between *B* and *C* and *A* and *D* respectively. But since the winding is symmetrical the voltage between *C* and *B* is equal to that between *D* and *A;* therefore there are equal voltages between *F* and *C* and *F* and *D*. In any other position of the armature the voltage between *F* and *C* is the resultant of half the voltage of the balance coil, and that of the armature winding between *C* and *B*. Correspondingly, the voltage between *F* and *D* is the resultant of those between *A* and *F* and *A* and *D*. But, as the voltages of *C* and *B* and *D* and *A* are always equal and *F* is the mid-point of the balance coil, it follows that the voltages between *F* and *C* must always equal that between *F* and *D*, and therefore *F* is the correct neutral point and may be connected to the neutral wire.

The current distribution in the windings of the three-wire generator under conditions of unbalance in load on the two sides is quite similar to that in a single-machine three-wire balancer. The current relations in the latter machine were described by Mr. George T. Hanchett in the *Electrical World* for Sept. 9, 1911, and they need not be discussed here.

The principles of operation with the three-wire generator are of decided importance in eliminating the cumbersome double-machine unit to operate a three-wire system. No special knowledge or experience is necessary to operate the machine successfully and after the balancing coils are once in position they require absoluely no attention or maintenance.

The small magnetizing losses in the balance coils can be neglected, so that the performance of the three-wire generator is practically identical with that of two-wire machines.

Three-wire generators are usually wound for either 250 volts or 500 volts in the larger units, and they may be compounded to give a rising voltage with increasing load, as is the standard practice with single-voltage machines. A common practice is to divide the series field turns into two parts, connecting one part in the positive and the other in the negative leads, in order to preserve the balance at all loads. Three-wire generators may be successfully operated in parallel with each other without danger of short-circuiting when the machines are brought up to speed, and they may also be operated in parallel with two-wire generators.

The balance coils are usually connected to the collector rings through switches, the neutral wire being taken to the switchboard. It is unnecessary to synchronize the alternating current sides of the armatures for parallel operation, nor is it necessary to consider the frequency generated by the different machines. Three-wire generators may be operated together irrespective of the number of poles and speed of each and can be regulated for equal voltage.

The possible applications of the three-wire system are quite numerous, but its principal fields of service are in the distribution of energy for lighting and motor service in office buildings, manufacturing plants, stores, machine shops, etc. It has been also successfully applied to mining service for distributing energy underground to distances between 1 mile and 2 miles. The two voltages delivered by these generators are convenient and advantageous for variable-speed motor operation, as the flexibility of the system provides a wide range of speeds with field control, while the saving in copper is an advantage which is likely to have considerable bearing on prospective installations.

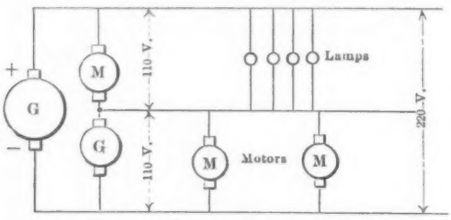


Fig. 2—Three-Wire System with Balancer.

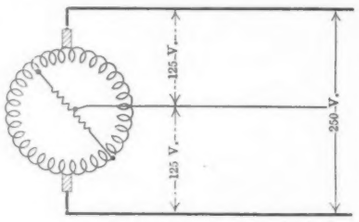


Fig. 4—Three-Wire Generator.

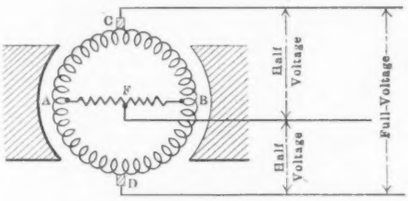


Fig. 5—Three-Wire Generator.

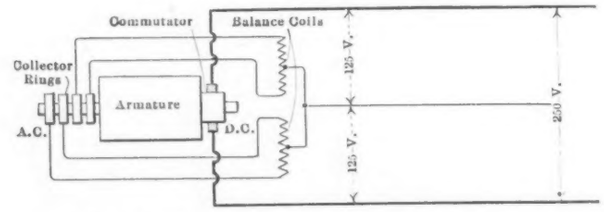


Fig. 3—Three-Wire System with Transformer.

COMMUTATOR-TYPE POLYPHASE MOTOR.

A number of tests are to be carried out by the electrical department of the University of Michigan, Ann Arbor, on a 10-hp commutator-type polyphase motor specially constructed for the university by the Fairbanks-Morse Company after the designs of Prof. Benj. F. Bailey. This machine is in some respects the polyphase counterpart of the new single-phase motors produced by several manufacturers. It is equipped with double sets of brushes for test operation on either two-phase or three-phase, 60-cycle current. Its speed can be adjusted over a wide range like a direct-current shunt motor, while its power-factor can be made unity or given a leading characteristic if desired. The oscillograph of the Ann Arbor institution has recently been applied to the study of ignition of gasoline engines, plotting the primary and secondary currents under different conditions of timing, condenser paths, etc.

Central Station
Management, Policies and Commercial Methods

BUSINESS BLOCK ORNAMENTAL LIGHTING.

Central stations which have developed business in connection with "white ways" in their respective communities have found retail merchants most responsive to an appeal on a basis of the advertising value of such illumination. Wholesale districts do not so easily adapt themselves to ornamental lighting, and it is unusual for a central station to go after such business. The George G. Fetter Heating & Lighting Company, of Louisville, Ky., has, however, successfully done so, and standards will shortly be erected along Main Street between Fourth and Fifth Streets. It is also likely that the standards will later be placed in other blocks along Main Street. The standards will be 55 ft. apart and will be equipped with tungsten lamps and ornamental opalescent globes. Work is to be begun early in March. Main Street is the wholesale, banking and financial district of Louisville, few if any retail establishments having their location there.

ELECTRIC-HEATING APPLIANCES IN NEW YORK.

The appliance departments of the New York Edison Company have recently had substantial increases in the sale of electric-heating appliances, particularly for special uses. Electrically heated wax melters, for sealing packages of various kinds, have been permanently installed by a number of the large banks in New York City, and about fifty customers of the central-station company, including a large express company, have wax melters on trial. Electric branding irons are being used by the United States Tire Company for branding the name and serial number on its tires. Electric branding irons are being used by the New York Edison Company for marking tools, stepladders and tool kits, and the Innovation Trunk Company, New York, is using the irons for branding coat and dress hangers which go in its trunks. Several of the New York newspapers are planning to use branding irons for marking their stands upon which papers are sold about the city. The *New York American* and the *Morning Telegraph* have installed electric felt burners in the last few weeks for burning the felt on the presses after it becomes thick and inky. There are many customers on the lines of the central-station company who are finding electric soldering irons very useful in their business.

FARM SERVICE NEAR NOBLESVILLE, IND.

Sixty farmers within a 3-mile radius of a point 5 miles east of Noblesville, Ind., are arranging to take electric service from a new 4400-volt extension to the system of the Noblesville Heat, Light & Power Company. The original plan was to form a club or company among these farm customers, assessing each his share of the cost of building the line extension. This idea originated among the farmers themselves, but had not progressed very far before the characteristic acumen of some of the agricultural gentlemen living nearest the town revealed to them that they would be bearing part of the burden for the lines to serve the more distant stockholders, so they promptly demanded a more favored rate.

This disrupted the original consumers' organization, and Mr. J. T. Kester, manager of the Noblesville company, then offered to have the central station build the lines, provided three customers were obtained per mile and five-year contracts were agreed to. The farm customers will thus furnish their individual transformers and the company the meters, energy to be charged for at the rate of 10 cents per kw-hr. for lighting and 5 cents for motors, the same as in the towns. The 4400-volt farm branches from the transmission trunk line will comprise No. 8 or No. 10 conductors carried on 25-ft. poles. Farms in this section of Hamilton County average 80 to 100 acres, and each customer will probably have use for 1 hp to 5 hp in motors. A minimum service charge will be made of $2 per month—preferably referred to as "$24 per year"—and 50 cents per hp for motors connected. Where two farm customers are within 1500 ft. or less of each other, a common transformer will be used, the more isolated services being made by stepping down directly from 4400 volts through individual transformers.

ATLANTIC (IA.) CHANGES FROM DIRECT TO ALTERNATING CURRENT.

By W. E. Byerts.

Nearly every central station distributing direct current to its customers finds itself "up against" the proposition of an enormous investment in copper for its distributing system as the town grows and the load increases. Even with very liberal mains the voltage will fall in outlying districts when the load comes on, even though the voltage at lamps near the power house keep up to normal. A great many central stations to-day are changing over to alternating current to get around these difficulties. It is the object here to take up some interesting features in connection with the recent change to alternating current in Atlantic, Ia.

Atlantic is a town of about 5000 population. The light plant is owned and operated by the town. Two-phase generation and distribution at 2300 volts and 60 cycles were adopted because of the ease of balancing the circuits with two-phase. The old plant was located close to town and was operated non-condensing. The new plant is located at the water-works plant to take advantage of condensing operation and to cut down the labor cost for attendance. The steam pumps were not changed, but the old building was torn down and a new one built which houses the entire pumping and electrical equipment. The boilers are separated from the pumps and generating equipment by a brick wall. Steam for all the apparatus is supplied from one steam header and goes into one condenser. Condensing water is supplied from a nearby creek.

The electrical equipment consists of three units. The largest one, rated at 230 kw, is direct-connected to a tandem compound Corliss engine. The two smaller ones, rated at 150 kw and 110 kw respectively, are direct-connected to Ideal compound engines. Four-wire distribution was adopted because the primaries had to be run under telephone wires in many places for some distance. By putting the two wires of the same potential on the inside it is possible for telephone men to climb up through the lighting primaries without endangering themselves. Two-phase lines are run downtown where the motors are located and single-phase in the residence districts. Motors and lights are run off the same primaries and generally off the same secondaries.

One of the difficult propositions was to arrange for some basis on which the change of the direct-current motors for

alternating-current motors should be made. Some customers had almost new motors and others had very old ones. Most of them were satisfied with their present motors and objected to paying for the change. It was finally decided that the easiest way out of the difficulty was to change all of the motors and fans free of charge to the customer and let the city taxes pay the expense. Accordingly this change of motors and fans was included in the contract for the new plant.

As the change of customers' motors and fans is always one of the difficulties encountered on a change from direct current to alternating current, the following figures of what it cost in Atlantic will probably be of interest. There were about seventy motors, aggregating 260 hp, and about ninety fans to be changed. Owing to the fact that the contractor did not finish the job, the city completed the work and bought the motors and fans. The entire lot of motors and fans with three or four exceptions were bought from the General Electric Company, which took the old motors in exchange. The entire lot of new motors and fans cost the town of Atlantic about $5,700. It received about $2,200 for the old apparatus, making a net cost to the city for the alternating-current motors and fans of about $3,500. In addition to this, the town had to set the new motors and install wiring, which cost about $300.

One of the pieces of apparatus which caused considerable difficulty was an induction coil which was used for X-ray work by a local doctor. It operated on 110 volts direct current and required considerable current when taking an X-ray photograph. The town is still undecided whether to replace this with a new one or to put in a small motor-generator set for supplying direct current to this and to a couple of dental motors which can only be replaced by buying a complete new motor and dental outfit. Another article which was expensive to replace with alternating current was a direct-connected coffee grinder. It was necessary to buy an entirely new grinder in this case, as the direct-current and alternating-current motors used were not interchangeable.

IRRIGATION PUMPING WITH ELECTRICAL ENERGY.

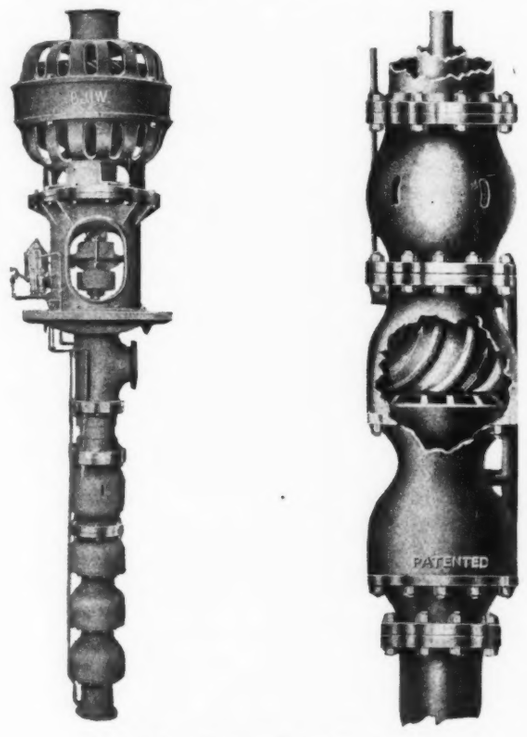
An interesting example of the use of electrical energy for irrigation pumping is found in a small development situated in New Mexico and known as the Portales project. This development embraces a total present area of 10,000 acres, which overlies a water-bearing formation at comparatively shallow depths, ranging from about 20 ft. to 50 ft. There are sixty-nine motor-driven pumping plants scattered over the project, each pumping from an individual well. The delivery head varies from 15 ft. to 35 ft., and the well capacities have been found to range from 900 gal. to 1700 gal. per minute. The wells were drilled to receive a 14-in. galvanized-iron casing. Through water-bearing strata the casings were perforated with slots 1 in. in length, ⅛ in. in width, spaced about ⅜ in. between transverse centers and 1¾ in. between longitudinal centers. In all installations the discharge pipe is 10 in. in diameter. Each pump is of the single-stage centrifugal type, direct-connected to a 550-volt, 60-cycle, three-phase induction motor, and the combined unit is installed in a well-pit of such depth that the water gradient is within lifting distance.

The energy for operating these installations is developed and distributed from a private plant situated in the city of Portales. This plant is equipped with three 500-hp producer-gas sets for operation with bituminous coal. There are two direct-connected generating units, each consisting of a 750-hp horizontal gas engine and a 600-volt, 60-cycle, three-phase generator. The manufacturer guaranteed the producers and engines to deliver a brake horse-power-hour on 1.2 lb. of coal, having at least 12,500 heat units per lb. In actual operation the manufacturer's guarantee has been exceeded. At full load, with fuel costing $5.20 per ton at the plant, the cost of energy, including fuel, labor, oil and waste, is less than 1 cent per kw-hr.

The distribution system comprises 38.4 miles of 11,000-volt, three-phase primary circuits and 35.4 miles of 550-volt, three-phase secondary circuits. The sixty-nine individual pumping plants reached by these circuits have an aggregate connected load of 1200 hp. There are seventeen step-down transformers, with a total rating of 540 kw. The entire system is owned by the farmers, who have taken up holdings on the project.

MOTOR-DRIVEN WATER-WORKS OF FOREST PARK, ILL.

The town of Forest Park, Ill., until recently operated a steam plant for furnishing its street lighting and pumping the city water supply. Hydroelectric energy from the lines of the Sanitary District of Chicago being available for municipal purposes at the low rate of $2.20 per hp-month for lighting and $1.25 per hp-month for motor purposes, it was then voted to replace the isolated-plant equipment with central-station energy, and a modern motor-driven pumping plant was installed. Allowing but 6 per cent depreciation and interest, the cost of running the old steam plant, pumping 450,000 gal. of water per twenty-four hours and operating 135 7.5-amp street arcs 7.44 hours per day, was $30,000 per year. The new equipment, which has a pumping capacity of 900,000 gal. per day, and the operation of



Deep-Well Vertical-Turbine Pump.

the same number of street lamps as before will cost less than $10,000 a year.

An artesian well 2000 ft. deep furnishes the water supply of Forest Park. This well is 15 in. in diameter throughout its uppermost 300 ft., tapering to 6 in. at the bottom. Normally the static level of the water is within 150 ft. of the surface, but a deep-well pump with 200-ft. shaft has been provided as a precaution against future lowering of the level by pumping down, etc. The Byron-Jackson six-stage

pump is shown in section in the accompanying illustration. A vertical 75-hp Sprague induction motor drives the pump-shaft at 1165 r. p. m. The eductor pipe through which the water rises is 8 in. in diameter. Within this is a 3-in. partition pipe inclosing the 2-in. pump shaft, which is thus entirely separated from the water line. Bearings support the shaft at close intervals, and these are lubricated by oil introduced into the shaft pipe. Lubrication for the propeller vanes and for the thrust bearing at the bottom of the shaft is provided through a small oil pipe lowered into the well outside of the eductor pipe. Not including the motor, the pump parts weigh 20,000 lb., and part of this weight is borne by a roller bearing at the top of the shaft. The latter is constructed in 12-ft. sections and can be dismantled through a rigging in the roof of the plant. As a precaution against possible breakdown of this pump, an air-lift is now being installed in an adjoining well, operated by a motor-driven compressor. This equipment, of course, has a much lower plant efficiency than the deep-well pump.

The deep-well pump discharges into two small subsurface reservoirs, from which the high-duty pumps take their supply through a 9-in. line. The discharge line of the deep-well pump is fitted with a check-valve which serves to break the vacuum in the discharge line when the pump is shut down. Were it not for this valve, the 200-ft. unbalanced leg of the siphon formed by the well shaft would quickly empty the reservoirs back into the well. The deep-well pump is able to deliver 700 gal. per minute.

For pumping into the standpipes and system of mains, three sets of R. D. Wood 6-in.-discharge, single-stage centrifugal pumps driven by 50-hp Sprague motors are installed. Their several discharge lines are arranged with connecting headers so that any two pumps can be connected in series for delivering fire pressure to the mains.

The several 440-volt motors about the plant are started from compensator panels in a switchboard in the pump-room. This switchboard is arranged with recording watt-meter, Columbia watt-hour meter and Roller-Smith phase ammeters.

Mr. Henry J. Mohr is Mayor of Forest Park, Mr. Edward Troost is chairman of the committee on water supply and street lighting, and Mr. C. C. McLain is consulting engineer.

CENTRAL-STATION MOTOR-SERVICE EARNINGS.

Unit Analysis of Sales of Electricity for Motor Applications in Six Massachusetts Companies.

The increasing use that is being made of electricity for motor service in manufacturing centers lends special interest to the analysis of energy sales in relation to connected load and population. The economic aspects of industrial electric power may be viewed from many angles, but the most suggestive method of inquiry rests upon unit determinations of earnings, installed capacity and outputs. Comparisons of data drawn from actual practice are helpful in stimulating inquiries as to differences among local conditions and tend to throw light in individual cases upon the direction toward which future policies may be aimed.

TABLE I.—MASSACHUSETTS CENTRAL-STATION STATISTICS.

	Attleboro.	Brockton.	Cambridge.	Lowell.	Lynn.	Worcester.
Motors, hp	2,070	3,470	6,130	7,510	5,080	3,600
Number of motors	233	....	818	616	746	895
Motor-service revenue	$43,671	$74,401	$118,881	$196,376	$85,483	$106,388
Motor-service customers	98	351	263	439	349	404
Kilowatt-hours sold for motor service	1,619,925	1,333,675	4,427,846	7,575,238	3,658,061	3,337,246
Population, Census of 1910, total territory served by each system	18,612	83,550	104,839	121,234	104,771	149,223

In the following tables are given figures bearing upon the marketing of electrical energy for motor service in the Massachusetts cities of Attleboro, Brockton, Cambridge, Lowell, Lynn and Worcester for the year ended June 30, 1911. The service in each case was supplied by a private company; every one of the communities is a manufacturing center of prominence, and in each company an energetic and progressive policy contributes to the expansion of its commercial service. Lynn, Cambridge, Lowell and Worcester all have populations of from 100,000 to 150,000 each, while Brockton is rapidly approaching the 90,000 mark. Attleboro, the only small place in the group, has a population of slightly under 20,000. Brockton and Lynn are world-famous shoe-manufacturing cities; Lowell is a noted textile center; Attleboro is one of the largest producers of jewelry in the world, and Cambridge and Worcester are well-known producers of machinery, metal products, textile equipment and other miscellaneous manufactures. In practically every case the local central-station company is developing its service along the lines of progressive expansion of its connected load in outlying districts as well as supplying the immediate municipality in which the maximum demand for motor operation occurs.

TABLE II.—MASSACHUSETTS CENTRAL-STATION STATISTICS EXPRESSED BY UNITS.

	Attleboro.	Brockton.	Cambridge.	Lowell.	Lynn.	Worcester.
Motor-service income per kw-hr., cents	2.7	5.6	2.68	2.6	2.33	3.15
Motor-service income, hp connected	$21.00	$21.40	$19.40	$26.10	$16.80	$29.40
Motor-service income, motor customer	$445.00	$212.00	$452.00	$447.00	$245.00	$263.00
Average motor hp	8.9	....	7.5	12.2	6.8	4.02
Average hp per motor installation	21.1	9.9	23.2	17.1	14.6	8.9
Motor-service income per capita	$2.34	$0.89	$1.13	$1.62	$0.82	$0.71
Motor-service, kilowatt-hours per capita	86.5	16.0	42.0	62.3	35.0	22.3
Average 24-hour motor load, kw	185.0	152.0	505.0	865.0	614.0	380.0
Ratio actual motor load to full yearly rating of all motors, per cent	12.0	5.9	11.0	15.4	11.0	14.1
Average number motors per motor-service customer	2.38	.....	3.1	1.4	2.1	2.2

Table I shows the total motor-service sales, population served, total energy consumed in motor operation and the average connected motor load and number of motors on the system of each company during the fiscal year 1911,

the averages being the mean of the company data at the beginning and end of the year.

These figures show that Lowell had the largest average connected motor load, the largest number of customers and the largest motor revenue during the year, Worcester having the largest number of motors in service and the largest population. Lowell also sold the largest amount of electrical energy for motor applications. It is of interest that the management of each of the above companies is now thoroughly in accord with the modern "new-business" ideas and that in each case systematic efforts are constantly being made to extend the commercial load.

Table II shows what the above companies did last year, from the unit point of view.

These data indicate that many opportunities exist for the popularizing of electric motor service and that, as a rule, the outlook is better for profitable motor business on the basis of relatively low prices than on the basis of higher net costs to the consumer. They show that, on the basis of each horse-power connected, the owner of an electric motor dealing with any one of the six companies receives his yearly service at a cost probably far below what he could realize if he attempted to generate his own supply of electricity, the range in the tabulation being roughly from $16 to $30 per year per connected horse-power in motors. The fact that a very large part of the above business was handled in the daytime unquestionably is the principal factor that justifies average returns of from 2⅓ cents to about 6 cents per kw-hour for this service. The fact that the average size of the individual motor ranged from about 4 hp to 12 hp shows that the central station is particularly strong in the small power field. Another significant point is the striking fact that, even in the most favorable cases, the full capacity of the motor installations is used for less than one-sixth of the year. In other words, the central station is drawn upon for the full rating of the motors connected to its lines for barely two months of each year, and the demand upon the capacity of the stations for a continuous supply of energy, if utilized for these two months, would, so far as the motor installations are concerned, cut practically no figure in the performance of the system during the rest of the year. It is the old story of intermittent demand, and suggests the advantages of cultivating long-hour motor service along every possible channel.

Wiring and Illumination

PHOTOGRAPHY IN PHOTOMETRY.

At a meeting of the New York Section of the Illuminating Engineering Society held on March 14 Dr. Herbert E. Ives presented a paper on "The Relation of Photography to Photometry," and Mr. A. H. Sawyer, of the Kinamacolor Company of America, delivered an illustrated lecture relating to motion-picture photography in nature's own colors.

Dr. Ives outlined the advantages and disadvantages possessed by photography as an aid to photometry. He stated that no advantage can be gained from using photography in the ordinary simple operations of photometry, such as the measurement of candle-power on a photometer bench. Only in those cases where the camera can do what the eye cannot should photography be considered. These may be practically confined to faint or transient phenomena. The photographic plate possesses two valuable properties, namely, it integrates faint or brief stimuli, and it records simultaneously actions which are extended in space. For example, an excellent use has been made of photography in analyzing the light of the firefly, which is too faint to be subjected to ordinary photometric measurements. Another important use of photography is in photometering light from fluctuating sources with complicated spectra, as, for example, in the measurement of the distribution of light of a flaming-arc lamp. The distribution of illumination around the arc lamp may be registered by photographing an annular strip of diffusely reflecting material illuminated by the arc and its center. In this way may be ascertained the mean distribution during the time of exposure, or a favorably steady moment may be chosen for the exposure. In order to ascertain the true visual distribution in such a case as that of an arc lamp, it is essential that the plate have the same distribution of color sensitiveness as the eye. This result may be accomplished by selecting the proper absorbing screens to use with the kind of plate employed. By using a screen composed of tartrazine, rhodamine, naphthol green and aesculine, used with a Cramer spectrum plate, it is possible to photometer lights of different colors without encountering the difficulty of comparing different colors in the visual work. Dr. Ives remarked that, except for comparatively rough work, the substitution of a photographic plate for the eye with a view to avoiding the difficulties of heterochromatic photometry is not to be seriously recommended.

In explaining the operation of motion pictures in nature's own colors, Mr. Sawyer stated that the original photographs for the films are taken at a speed of thirty-two exposures per second, as compared with sixteen exposures in the ordinary motion-picture film. Alternate exposures are taken through a red filter and other exposures through a green filter. In displaying the pictures the machine is so arranged that light from the arc lamp must pass alternately through a green and a red filter, identically in sequence with the method of procedure in obtaining the original photographs. The red and green pictures, although alternating in appearance upon the screen, appear to the eye as superposed simultaneously in proper proportions to give correct densities and colors to the objects being reproduced.

Discussion.

Mr. Norman Macbeth displayed certain photographs which had been taken with the object of showing the relative glares from different lighting equipments, the assumption being made initially that the photographic plate is sensitive in the same manner as is the eye to glare phenomena. Contrary to expectations, it was found that the photographic plate does not display the relative glares in the same proportion as is recorded upon the retina of the eye.

Dr. H. H. Seabrook expressed the opinion that it is not correct to assume that the retina itself acts differently from a photographic plate merely because the eye as a whole seems to differ in sensitiveness from the photographic plate. The light which reaches the retina must pass through the absorbing medium of the eye lens, and the absorption of this medium may be such as to act selectively with reference to the different light rays.

Secretary A. J. Marshall announced that at the meeting of the section to be held on April 11 two papers will be presented, as follows: "The Lighting of Passenger Boats," by Mr. L. C. Porter, and "The Elimination of the Personal Factor in Testing," by Mr. Warner M. Skiff. At the meeting to be held on May 9 the society will co-operate with the American Institute of Architects, and on June 13 a joint meeting will be held with the American Institute of Electrical Engineers.

President V. R. Lansingh stated that the membership of the society at the present time totals about 1400. Plans are now being completed for the formation of a section in Pittsburgh, where considerable interest has recently been demonstrated. Preliminary arrangements are now being made for the annual convention, the date and place of meeting of which have as yet not been selected.

ON THE ULTRA-VIOLET ENERGY IN ARTIFICIAL LIGHT SOURCES.

By Louis Bell.

It has long been known that the ultra-violet rays of the spectrum are, if of sufficient intensity and under favorable circumstances, capable of producing specific injurious action upon the eye. The first observations on this subject run back to the early days of the electric arc, nearly a half century ago, and with the increasing use of powerful light sources, which from the high temperature of the radiating body or peculiarities in the distribution of energy give a large amount of energy in the ultra-violet part of the spectrum, enough cases of irritation of the eyes have occurred to bring the subject into something of prominence. It should be understood at the outset that most of the unpleasant symptoms associated with glaring or misplaced lights are not due to any specific action of the radiation, ultra-violet or other, but are cases involving strain of the ocular muscles which makes itself strongly felt in the central nervous system. The serious symptoms associated with astigmatism, for instance, have no particular relation to the kind of light concerned, but merely represent the result of vain efforts on the part of the ocular muscles to obtain clear definition under impossible conditions, with the resulting reflex action on the nervous system. The specific action of various radiations on the eye has been often studied within the last few years and the facts brought to light may be briefly summarized as follows:

The cornea of the eye absorbs in general radiation below about wave-length 300 μμ. In virtue of this absorption by the cornea and external surface of the eye generally, energy is there spent which makes itself perceptible by setting up an inflammatory condition and in serious cases damaging the corneal epithelium. Indirectly there are associated with this reflex conditions which temporarily produce a good deal of discomfort. The same radiations affect the epithelium elsewhere than on the cornea, producing a condition which substantially is sunburn, whether received from natural or artificial light.

The resulting condition because of its early observation in connection with exposure to naked arc lights has become known as ophthalmia electrica. According to Van Lint ("Accidents Oculaires Provoqués par l'Électricité," page 100), the prognosis is always favorable and the opththalmia electrica runs normally a course of about five days, sometimes but rarely being extended to a somewhat longer period. The symptoms have a latent period of some hours which is extremely characteristic of this particular disorder. The particular portion of the ultra-violet here referred to is therefore under indictment as causing the symptoms just described. The rest of the ultra-violet spectrum, and in fact the extreme violet, which is very rich in actinic rays, is equally under suspicion as producing specific injury to the eyes, but of a different kind. Schanz and Stockhausen (*Zts. f. Augenheilk*, May, 1910) held that the particular kind of irritation already described may be produced by ultra-violet of wave-length up to 320μμ, a statement which finds its justification in the production of exactly these symptoms in the case of snow blindness. The solar spectrum is cut short by atmospheric absorption very sharply at about wave-length 300μμ, only a very trivial amount of energy of less wave-length ever being present; but, as shown by Fig. 1, between wave-length 300μμ and 320μμ the solar spectrum is fairly brilliant, so that a sufficiently severe exposure to it is quite certainly not without effect.

Aside from the absorption of the shorter wave-lengths by the cornea, nearly the whole of the ultra-violet, reaching almost to the very edge of the visible spectrum, is cut off by the absorption of the lens which prevents us from seeing into the ultra-violet, and practically the whole ultra-violet which reaches the lens has been found to produce certain fluorescent effects in the lens itself. This absorption has been held by Widmark ("Ueber den Einfluss des Lichtes auf die Linse," *Mitteil. aus der Augenklin. des Carolin-Medico-Chirurg-Inst. z. Stockholm*, H. 3, 1901) to produce injury to the lens, and by Schanz and Stockhausen (v. Graefe's *Arch. f. Ophthalm.*, Bd. 77) this particular region of the spectrum is held to produce glass-blower's cataract. This fluorescence of the lens with its possible effects is shown by Widmark (*loc. cit.*) to extend clear into the violet of the spectrum. Finally, in early youth it has been shown by Hallauer (*Klin. Monatsbl. f. Augenheilk.*, Dec., 1909, that the lens may transmit rays from about 330μμ to 315μμ to a moderate extent, so that such ultra-violet rays may penetrate clear to the retina, and Birch-Hirschfeld (*Zts. f. Augenheilk.*, 1908) has held these transmitted rays responsible for possible injury to the retina. It should be noted that the injuries reputed to be caused by the ultra-violet and extreme violet rays which are not stopped by the cornea are intrinsically of a more serious character than those produced by the extreme ultra-violet, inasmuch as they possibly involve permanent rather than strictly temporary injury.

Without going further into this very intricate subject involving many points which have been actively disputed and may be in considerable doubt, it is sufficient here to call attention to the fact that the possibly injurious rays, which are under direct suspicion on clinical evidence, extend from the extreme ultra-violet clear up to and into the violet of the visible spectrum. But all through the literature of this subject there is a singular absence of anything like quantitative investigation of the radiations, which if of sufficient intensity might produce harm. The organism possesses recuperative powers of a remarkable character and is not injured by an indefinitely small amount of energy. It is only when the rate at which energy is received is high enough to overcome the resistance of the organism, and to induce destructive changes faster than the repair department can take care of them, that actual injury is to be expected.

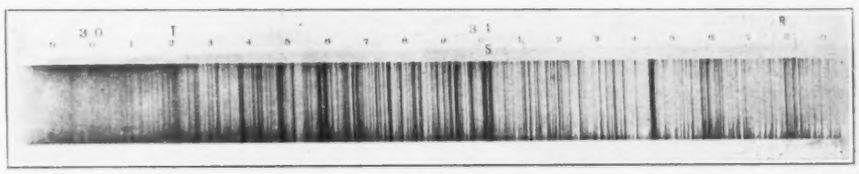
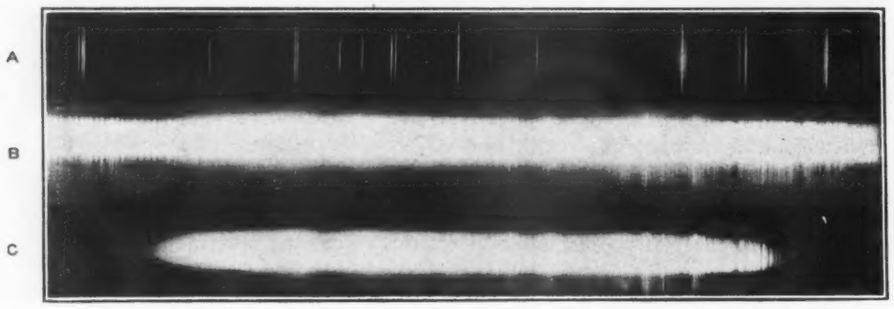


Fig. 1—The End of the Solar Spectrum in the Ultra-Violet.

The present research has had for its object an actual determination in dynamical units of the ultra-violet radiations produced in the operation of ordinary artificial light sources, so that the energy which is available for injurious action can be evaluated. Further, for the practical purposes of artificial lighting the sole question of importance is the possible amount of injurious radiation accompanying a definite amount of luminous radiation. For a given illumination that source has the least potentiality for harm which gives the least amount of possibly injurious radiation per foot-candle, and obviously no light source, whatever the amount or character of its ultra-violet radiation, can be reckoned as harmful if the quantity of possibly injurious radiation received from it falls below the minimum which can effect physiological changes. This last matter will be dealt with in a further investigation.

The method of investigation adopted was to separate the ultra-violet portion of the spectrum from the remainder by means of a suitable screen which completely absorbed

the ultra-violet while transmitting freely the other radiations. Such separation of distinct regions of the spectrum by suitable absorbing media has been carried out with reference to other portions of the spectrum than the ultra-violet by Lux (*Zts. f. Beleuchtungswesen*, H. 16, p. 36, 1907), Féry (*Bull. Soc. Franc. de Phys.*, p. 148, 1908),



A—Mercury arc. B—Magnetite arc without globe. C—Magnetite arc absorbed by Euphos glass.

Fig. 2—Absorption by 2 mm of No. 1 Euphos Glass.

Voege (*Illuminating Engineer*, London, Vol. II, p. 10) and others, and has been by a somewhat intricate method extended to the examination of groups of spectral lines by Buisson and Fabry (*Compt. Rend.*, Vol. 152, p. 1838).

For the present purpose a medium was sought which would effect a partition of the radiations of short wave-length reputed to be injurious from the rest of the spectrum. This called for absorption ending in the extreme violet of the visible spectrum and sufficiently strong to wipe out the entire ultra-violet region. Such a medium was found after a little spectographic investigation of various specimens in the Euphos glass No. 1. This is the protective glass devised and recommended by Schanz and Stockhausen for the very purpose of cutting out all the possibly injurious rays, the aggregate amount of which it was the purpose of this investigation to determine. The absorption of this glass becomes complete in the edge of the ultra-violet and fades off through the further violet into remarkable transparency in the blue and so on through the spectrum into the infra-red. The character of the absorption produced by a disk of No. 1 Euphos glass 2 mm thick is well shown in Fig. 2. Here *A* is the spectrum of the quartz mercury arc thrown upon the film as an index, *B* is the spectrum of the magnetite arc without its glass globe, and *C* this spectrum as absorbed by the Euphos glass. The group in the mercury spectrum at the extreme right of the strip is near wave-length 365μμ. The two strong lines next to it on the left are those at 404μμ and 407μμ, near the end of the violet, and the single strong line a little further to the left is the very brilliant blue line at 435μμ. These will serve to locate the absorption of the Euphos glass. At the other end of this spectogram *C* fades away owing to the failure of the sensitiveness of the film at about wave-length 700μμ.

The method of investigation adopted was to receive the radiation from the source under investigation on a Rubens thermopile consisting of twenty constantin-iron couples inclosed in a vacuum tube provided with a quartz window just in front of the exposed junction. The thermopile was connected with a sensitive galvanometer, the deflections of which were read by a telescope and scale at a distance of 1.5 m. The combination was standardized by the radiation from a standard carbon incandescent lamp, and it was found that 1 mm on the scale equaled 35.3 ergs per second per square centimeter at the thermopile. It thus became possible to measure in terms of absolute units the ultra-violet radiation in any source investigated. Although both thermopile and galvanometer gave very closely proportional deflections, the additional precaution was taken of working so far as was practicable with the same general magnitude of absolute deflection.

The radiometric apparatus thus set up worked admirably, although the time required for a galvanometer deflection, one minute, was at times inconveniently long and there was as usual with thermopiles a slight drift of the zero point, quite regular, however, and easily taken care of by means of a time correction. To bring the total deflection within convenient limits and to eliminate absorption in the far infra-red due to the insertion of the Euphos glass a cell of distilled water 1 cm thick, with quartz sides, was kept in front of the thermopile window. Both quartz and water are wonderfully transparent for the ultra-violet, but cut off the infra-red rays in this thickness at about wave length 1300 μμ. The separation effected was therefore between the whole ultra-violet region and the visible spectrum reaching down to wave-length 1300 μμ in the infra-red. The Euphos glass when in use was fastened to the front of the quartz water cell by spring clips with a very thin capillary layer of pure glycerine interposed. Glycerine is extremely transparent to all the radiations concerned and had the advantage of wiping out the correction for reflection at the air-glass surfaces of the Euphos disk which would otherwise have been necessary. In fact, the index of refraction of the Euphos being slightly less than that of the quartz, a small differential reflection factor existed tending to compensate for the minute absorption of the glycerine film.

Preliminary tests of the behavior of both Euphos and light crown glass thus attached to the water cell showed that the Euphos outside of its region of special absorption was quite as transparent as clear optical glass and that the latter plus the glycerine film added to the absorption of the cell by a quantity not exceeding 0.5 per cent. This small figure is of course due to the fact that the water and quartz absorb the whole region within which glass shows material absorption in the infra-red, and is quite in accordance with the data that have been given by Schott & Genossen, at Jena, for the absorption of similar optical glass. There is, of course, aside from any question of specific absorption a slight virtual absorption in the ultra-violet regions due to increased loss by reflection at the surfaces in accordance with Fresnel's formula $\left(\frac{n-1}{n+1}\right)^3$. This was effective at the first and second surfaces of the quartz cell and at the two surfaces of the quartz window of the thermopile and therefore numerically proportional to the fourth power of the transmission coefficient determined from Fresnel's equation. No account was taken of this differential reflection in these experiments, as it actually amounted in nearly all cases to considerably less than 1 per cent of the total ultra-violet recorded. The observational errors with the thermopile proved to be about the same magnitude as those which would be found in the photometry of the same sources. If these were fairly steady, the mean deviations of single observations from the average of the set was commonly within 0.5 per cent.

The light sources studied included arc and incandescent lamps of various types, the Welsbach mantle and the acetylene flame. It is altogether a mistake to suppose that the ultra-violet spectrum of any of the commercial light sources is a negligible quantity. Even a kerosene lamp gives on the spectrograph a photographic record extending to wave length 350μμ, while the acetylene burner, the Welsbach and the metallic-filament lamps give spectra reaching into the far ultra-violet, in the case of the tung-

sten clear down to wave-length 300μμ in spite of its thin inclosing glass. (Schanz and Stockhausen, *Zts. f. Augenheilk.*, May, 1910). All these sources, therefore, reach down into the region of the extreme solar spectrum which is known to produce specific action upon the eye. The quartz lamp and various forms of electric arc without the customary inclosing globes give spectra reaching down into the ultra-violet below wave-length 250μμ (Schanz and Stockhausen, *loc. cit.*), and with their globes the spectra terminate at about the same point as the solar spectrum.

The first light sources investigated were incandescent electric lamps, the "Gem" and the tungsten. The former, despite the fact that its spectrum runs down quite to wave-length 320μμ, gives on the whole a very small proportion of the rays cut off by the Euphos glass. Only 2.6 per cent of the total radiation which passed the quartz water cell was thus cut off, as might well be expected from the relatively low temperature of the source. The tungsten lamp, much whiter to the eye and worked at a very much higher temperature, shows, as might be expected, a considerably greater proportion of short wave-length radiation, the cut-off being substantially 6 per cent. The difference between the two is about what might be expected from the much greater richness of the tungsten light in the blue end of

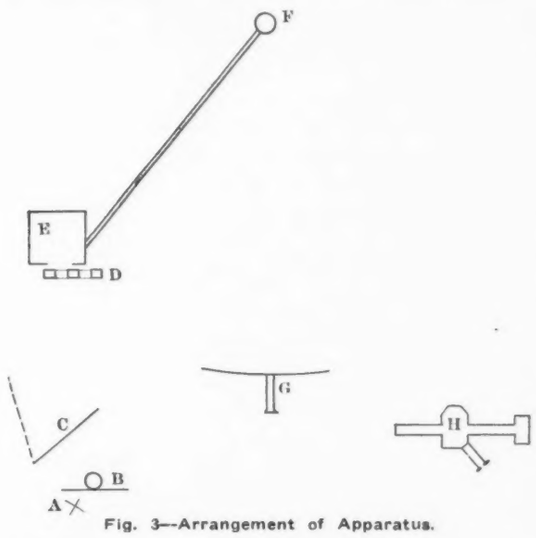


Fig. 3—Arrangement of Apparatus.

the spectrum, a difference very striking when the spectra of the two sources are seen side by side.

The next source investigated was the ordinary glass Cooper Hewitt tube, of which a section giving 100 cp was screened off in order to get radiation on the thermopile from the whole area examined. The total deflection due to the radiation from the length of tube examined was only a fraction of the radiation received from the "Gem" lamp previously studied, although the tube gave two and one-half times as much light. The cut-off of the ultra-violet effected by the Euphos glass amounted to 41.7 per cent of this total energy. The total ultra-violet radiation per cp differed very little from that in the "Gem" lamp. The relatively small total deflection produced by the mercury lamp is, of course, largely due to the fact that it is of much the higher luminous efficiency. The percentage of ultra-violet energy in all these cases is a matter of only secondary importance, the fundamental quantity measured being the actual ultra-violet radiation of the source.

Some interesting comparative results were also obtained from the Welsbach mantle and from the acetylene flame. The former source was actually a Graetzin single inverted mantle street lamp fitted with a clear glass globe. The burner took 6.4 ft. of gas per hour at 3-in. water pressure and gave 75 horizontal cp. The percentage of cut-off by the Euphos glass screen was 8.4, but, as with the mercury tube, the ultra-violet per cp was very low and the total deflection small.

The acetylene flame was from a burner such as is ordinarily used in automobile lights, fed from a Prestolite tank and measuring 27.35 cp. Four and a half per cent of the transmitted energy was cut off by the Euphos glass while the ultra-violet energy per cp remained low, a little lower than in the case of the tungsten lamp.

Prior to taking up the investigation of arc lights, which give considerable trouble from unsteadiness, a slight change was made in the method of experimentation. A second quartz water cell was provided and its coefficient of absorption determined with reference to the first cell. The Euphos glass disk was clamped to one of these cells with the intervening glycerine film, and the two cells were thrust in succession in front of the thermopile and readings taken in the usual way. With perfectly steady sources the Euphos disk on a single cell could readily be removed and replaced. Also provision was made for taking photometric readings on the light sources in the middle of the radiometric observations. To this end the apparatus was arranged as shown in Fig. 3, where *A* is the source, *B* an adjustable sector disk, *C* a plate-glass mirror, of which the constant of reflection had been thoroughly determined, arranged to be quickly dropped into position in the path of the beam, *D* the duplicate quartz cells, *E* the thermopile, *F* the galvanometer, *G* the telescope and scale, and *H* a portable photometer ready to be put into action on the closing of the switch upon its standard lamp. When the source was burning steadily and candle-power readings were desired it was only necessary to start the disk, drop the mirror *C* into position and measure the candle-power on the photometer *H*.

Prior to beginning work on the regular arcs the quartz mercury arc was investigated. Two lamps were available, one of French and one of American manufacture, both rated at 3.5 amp on a 220-volt circuit. The French mercury lamp had been in use for other purposes for about a year and was not at the start a duplicate of the American one, so that the difference between the two is readily understood. The American lamp was fitted with a light "Alba" globe which was used in some of the experiments. The actual deflections produced by these mercury lamps were singularly small, as in the case of ordinary mercury tube. When used without their globes the percentage of ultra-violet cut off by the Euphos glass with respect to the total energy transmitted was large, being 55.7 per cent in the French lamp and 65.1 per cent in the American lamp. The light-giving efficiency of these lamps used without their globes being relatively small, the ultra-violet energy per cp ran high, higher than in any source investigated except in a special form of inclosed arc.

Tests made on these lamps by the substitution of a disk of light optical crown glass, which absorbed the ultra-violet from the extreme limit to about wave length 300μμ, enabled a partition to be made between the extreme violet thus defined and the portion of the ultra-violet reaching up to the visible spectrum. Such tests showed that practically one-half of the total ultra-violet radiation was of wave length 300μμ or less. Nearly all the remainder of the ultra-violet radiation lies between wave-length 365μμ and the visible spectrum.

A very singular gap exists in the mercury spectrum reaching between wave-length 313μμ and wave-length 365μμ. In this entire region there is only one line of material strength, at wave-length 334μμ. Curiously enough, this gap lies exactly in the region in which, according to Hallauer (*loc. cit.*), the lens of the eye is somewhat transparent in youth, that is, from 315μμ to 330μμ. Consequently no rays from the quartz lamp can reach the retina until one approaches the beginning of the visible spectrum, the lamp being without perceptible radiation in the only region to which the lens is transparent even in youth.

When inclosed in its regular globe the quartz lamp runs at a higher temperature, gives enormously increased luminous efficiency and shows by far the smallest amount of ultra-violet per cp of any of the light sources investigated. This is little wonder considering the fact that the light-producing radiations of the lamp work at an average efficiency of about 50 cp per watt (Buisson and Fabry, *Compt. Rend.*, Vol. 153, p. 254). Incidentally the result here obtained for the efficiency of the quartz arc without its globe, as a source of extreme ultra-violet rays, was compared with that obtained by Buisson and Fabry by a slightly different method (*Compt. Rend.*, Vol. 153, p. 93) and the results were found to check very closely, thus affording independent confirmation of the general accuracy of the method employed.

The ordinary electric arcs were then investigated. They gave on the whole considerable trouble from unsteadiness, and two of them, the open carbon arc and the yellow-flame arc, proved practically unmanageable, considering the long period of the galvanometer employed. The inclosed arc at 6.6 amp direct current was easier to manipulate when the position of the arc was steadied by a weak magnetic field. When equipped with a globe having a quartz window permeable to the ultra-violet the inclosed arc proved a very powerful source of radiation of short wave length. Thirty per cent of the energy was cut off by Euphos glass and the total energy in the ultra-violet ranged higher for his particular lamp than for any other tested. The spectrum extended considerably below wave-length 300μμ, but a large factor in its strength would seem to be due to the two enormously powerful bands between wave-lengths 380 μμ and 390 μμ and between 350 μμ and 360 μμ respectively. A comparatively small change, therefore, is made by the interposition of the glass globe.

Next the magnetite arc with and without its globe was investigated. The spectrum, as shown in Fig. 4, reaches far down into the ultra-violet to below wave-length 240μμ and is particularly strong between wave-length 300 μμ and the visible spectrum. Deflections due to the ultra-violet were of substantially the same magnitude as obtained for the quartz lamps without globes, the glass globe of the magnetite arc cutting off about 22.5 per cent of the total deflection.

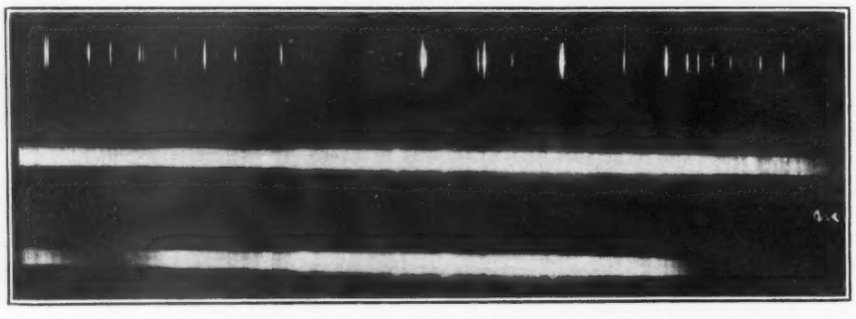
An investigation of the Nernst lamp proved somewhat interesting. Without its globe it proved decidedly unmanageable on account of its hypersensitiveness to drafts. With the globe it gave a slightly greater ultra-violet output per cp than did the tungsten or any other incandescent lamp.

Finally an investigation of the ultra-violet component in sunlight was undertaken. For this purpose the solar rays were received on a porte-lumière equipped with a nickel mirror, which reflects the ultra-violet particularly well. The beam thence passed to a 3-mm stop which formed the solar image on the window of the thermopile. Close alongside the thermopile was set up a Simmance-Abady flicker photometer, the brilliancy of the solar image received being balanced against a calibrated tantalum lamp, of which the current supply was varied with a rheostat and milliampere meter in circuit. The sun acts practically like an incandescent source at about 6000 deg. C., of which a large part of the ultra-violet energy is scattered or absorbed by the atmosphere before reaching the level of the earth. Twenty-one per cent of the energy which passed through the quartz water cell was cut off by the Euphos glass screen, but the high luminous efficiency cut down the relative ultra-violet to a point approximating that reached by high-efficiency incandescent lamps. It should be remembered, however, that the light received from the sky, which is often comparable in intensity to that received directly, is mostly composed of ultra-violet and violet rays scattered in the passage through the atmosphere, and hence brilliant daylight often contains a proportion of ultra-violet with respect to the luminous rays two or three times as great as that measured and approximating that received from arc lamps and other powerful sources of ultra-violet energy. This difference accounts for the very discordant results which have been obtained in actinic measurements of the ultra-violet in sunlight and likewise under different conditions of weather and altitude.

RESULTS OF INVESTIGATION OF ARTIFICIAL LIGHT SOURCES.

Source.	Deflections due to U. V., in Centim'rs	Total U. V. Ergs per Second per Square Centimeter	U. V. Ergs per Second per Square Centimeter per Ft.-candle.
Quartz arc ("Alba" globe)	3.70	1305	4.3
Graetzin	.92	...	11.7
"Gem" Lamp (100 watt)	.61	215	14.8
Cooper Hewitt (glass)	1.64	577	15.5
Sunlight (direct)	2.28	...	16.1
Acetylene flame	.52	...	18.4
Tungsten lamp (100-watt)	1.90	670	22.7
Nernst lamp (globe)	1.81	640	25.5
Magnetite (glass)	22.40	7,900	30.3
Magnetite (quartz)	29.00	10,240	36.3
Old quartz lamp (bare)	16.77	5,920	38.3
New quartz lamp (bare)	32.10	11,350	87.6
Carbon arc (quartz)	74.00	26,200	91.0

The accompanying table shows in the first column the several sources investigated, in the second column the observed deflection difference at 0.5 meter standard distance due to the energy cut off by the Euphos screen, in column 3 the total of this energy in ergs per second per square centimeter, and in column 4 the energy in terms of ergs per second per square centimeter per foot-candle. This last column measures the energy delivered in the whole ultra-violet region for a given value of the illumination. At the head of the list stands the quartz mercury arc equipped with its standard "Alba" globe, a position which it owes to its enormous luminous efficiency and to the considerable proportion of its ultra-violet spectrum absorbed by the globe. The Graetzin gas lamp, thanks to its high luminous efficiency, took the second place. Beyond this follow the group of incandescent bodies, among which falls the ordinary mercury tube. At the end of the list come various forms of arc lamps, including the quartz lamps without globes, with a considerable proportion of ultra-violet in their spectra. Although all of them are sources at fairly high temperature, they unite in owing a considerable amount of ultra-violet energy to highly selective radiation. From the respective spectra the ordinary open arc should fall near the beginning of this group and the calcium fluoride flaming arc near its end.



A—Mercury arc. B—Magnetite arc without globe. C—Magnetite arc with globe.

Fig. 4—Comparison of the Spectra of Mercury-Arc Lamp and Magnetic-Arc Lamps With and Without Globe.

In the sense explained at the beginning of this paper the last column of the table represents the relative potential powers for injury in the several sources, but the writer here desires to put on record his conviction that, in view of the actual magnitudes shown for the ultra-violet radiation, none of these sources can be regarded as practically dangerous if treated with the respect properly due to unpleasantly brilliant sources of light. Injury from any of them is in the last resort dependent on the reception of an amount of energy not likely to be received in any casual or accidental manner, and while definite injuries have been reported even from ordinary incandescent lamps, the dynamical data here given indicate that the dangers of ultra-violet radiation have often been grossly over-estimated.

RECENT TELEPHONE PATENTS.

TELEPHONE SETS.

As the uses of the telephone become more and more diverse it is necessary to devise sets of different forms to withstand the different conditions. We thus to-day have sets specifically arranged for dispatching, for use with wires, car sets, marine sets, etc. With some convenience for the particular service rendered is the factor of prime importance, while with others the exposure plays an important part. It is this latter which determines the design of a waterproof set for which a patent has been obtained by Mr. E. A. Graham, of Brockley, England. Both transmitter and receiver are located within the casing. The sound passages from the latter are tubes which are positioned to meet both ears of the user, being adjustable about a horizontal axis which leaves the casing through stuffing boxes. The transmitter mouthpiece is normally closed by a plate across the bore. A switch manually operated controls the circuits and incidentally substitutes a screen for the solid plate in the transmitter mouthpiece as well as giving the rear electrode of the microphone button a slight rotation to overcome any packing tendency.

AUTOMATIC SYSTEM.

Mr. George W. Lorimer, of Piqua, Ohio, has obtained a patent which relates to improvements in an automatic system. It seems that, as originally arranged, an accidentally grounded line could in error appropriate a considerable proportion of the apparatus and thus defeat the system. The improvement overcomes this faulty action even though a ground be continually maintained. This patent is assigned to the Western Electric Company.

DISPATCH CIRCUIT.

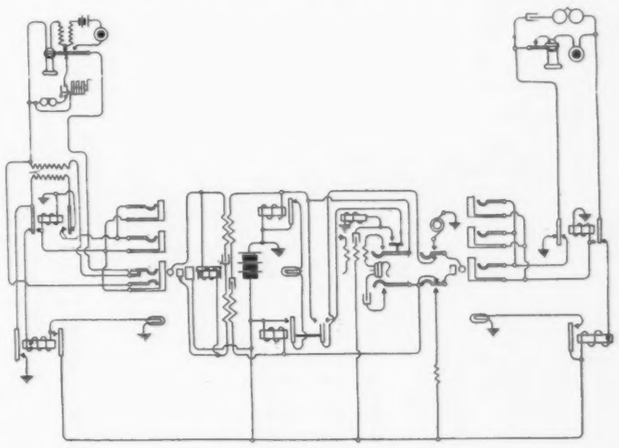
On a dispatch wire, if a selective device is used, abrupt makes and breaks of the selector current will seriously affect any existing conversation. If the current impulses can be rounded off so that the potential change is fairly gradual, the effect is largely eliminated. The patent granted to Mr. E. R. Gill, of Yonkers, N. Y., describes the method of inserting retardation coils and condensers to obtain this result.

REGISTERING DEVICE.

The patent issued to Messrs. J. L. Rue and C. F. Brown, of Coshocton, Ohio, jointly, describes a switchboard circuit system with special features to provide a reliable busy test. The system includes not only the busy test for connecting cord pairs, but also that required upon trunks. Where telephone service is paid for upon the basis of duration of use it is necessary to introduce a time-recording feature. Where different rates are charged for the same time for different classes of service, the problem becomes more intricate. Mr. G. Babcock, of Rochester, N. Y., has, however, produced a system for this method of recording. At the subscriber's station the registering device proper is mounted. At the central office there is a spring-winding mechanism operated by a pawl which responds to current impulses. Any required rate of winding may be used, as there are provided the required number of different impulse circuits, each with its own rate. Any of these may be connected by means of keys, one for each impulse rate. It will be seen that the amount of power stored in the spring depends upon the rate and the duration of application. At the end of conversation the operator permits the spring to run down, sending out impulses to the station, where they are counted upon the register.

SWITCHBOARD CIRCUIT.

At times it becomes advisable to terminate long local battery lines upon the regular line terminals of common-battery switchboards. The circuit system patented by Mr. F. M. Davis, of Chicago, shown herewith, provides for



Telephone System.

such an arrangement. It will be noted that the cord circuit has a repeating coil toward the local battery line, while the line circuit of the local line is so arranged that a repeating coil is inserted between the multiple jack and the line. The repeating coil is cut in as the cut-off relay operates. This patent is assigned to the Kellogg Switchboard & Supply Company.

Letter to the Editor

ELECTRICAL METHOD OF DETERMINING RECALESCENCE POINTS.

To the Editor of Electrical World:

Sir:—In your issue of March 16 there appears an article, "Electrical Method for Determining Recalescence Points," giving a description of a double reflecting galvanometer, in which it is stated that the galvanometer was developed by Mr. A. Schramm and was placed on the market in Germany.

Permit me to point out that this galvanometer has been known for many years as the "Saladin" apparatus and was invented in 1903 by a French engineer, Saladin. (See "Measurement of High Temperature," by Burgess and Le Chatelier.)

The special design described in the article was developed in the laboratories of Siemens & Halske, A. G., Berlin, and Siemens & Halske's price list, No. 55, of 1909 contains an illustration of this apparatus which is identical with the one published on page 604 of your issue of March 16.

Dr. Karl Georg Frank,

New York. *Representing Siemens & Halske A. G. and Siemens-Schuckertwerke, G. m. b. H., Berlin, Germany.*

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Flashing Over in Commutator Machines.—W. W. Firth.—By the term "flashing over" is meant the formation of an arc with explosive violence between the brushes of a commutator machine subjected to abnormal conditions of load. In every case the flash-over appears to be associated with high-current density in the brushes and excessive sparking. There are only two possible reasons for an arc forming between the brushes, either an abnormal rise of voltage or a decrease of resistance, but since the former is not likely, there is left only the second alternative, namely, the establishment of a conducting path between the brushes. Here, again, there are alternatives to consider, as the path may consist of carbon particles liberated from the brushes by excessive sparking or of a series of local arcs across the segments. It is likely that both agencies are concerned, imperfect commutation as a primary cause and carbon dust as a secondary one; probably the function of the dust is to reduce the resistance of the arcs over the mica insulation. The real solution of the problem of flashing over is to design the machines with good commutation and with an ample allowance of insulation between the segments. In machines which are subject to the trouble a most effective solution of the problem has been attained by the use of asbestos-faced wipers placed between the brushes and extending the full length of the commutator. With these wipers in position it was found to be impossible to produce a flash-over under the most extreme conditions of load and sparking. A further advantage in the use of the wipers is that the surface of the commutator is kept quite clean and normal sparking is reduced to a minimum. The only drawback to their use is that they retain the carbon dust and after a time become dirty. This points to the advantage of using thin wipers set close to the trailing tips of the brushes and arranging them so that they may be easily cleaned or renewed. The arrangement now used is to make the brush box double, the second compartment carrying the wiper. On the heaviest short-circuit sparking is confined to the narrow space between the brush and the wiper.—London *Electrician*, March 22, 1912.

Design of the Dynamo-Electric Machinery.—A. E. Clayton.—Since the element of the design of a dynamo is the pole group, it is reasonable to design a machine from the point of view of the individual pole group rather than that of the machine as a whole. The author gives an outline of a method of doing this. The paper, which is of a mathematical nature, is to be concluded.—London *Electrician*, March 22, 1912.

Single-Phase Commutator Motors.—P. Müller.—The first part of an illustrated paper read before the Dresden Electrical Society. In the present article the author discusses the general principles of the series and repulsion types of motor and the different factors which influence commutation, especially the form and arrangement of the windings. The paper, which has special reference to motors of the Bergmann Electric Company, is to be concluded.—*Elek. Zeit.*, March 21, 1912.

Lamps and Lighting.

Economy of Modern Flame-Arc Lamps.—W. Hechler.—A long illustrated paper read before the Berlin Electrical Society on the possibilities of increasing the efficiency of flame-arc lamps. One possible method would be to reduce the power wasted in the series resistors by using impregnated carbons for which the voltage at the terminals can be raised, while maintaining the same line voltage as now employed. The specific power consumption in the arc does not decrease continually with increasing voltage, but reaches a minimum at a certain point, which depends on the electrode material. This fact, together with the high light emission of the arc itself (the emission from the arc itself as distinguished from the electrodes being from 55 to 60 per cent of the total light), leads to the conclusion that short

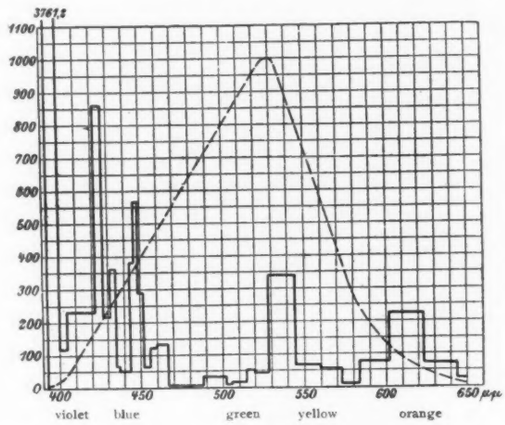


Fig. 1—Energy-Flow Distribution in Spectrum of Yellow-Flame Arc Lamps.

arcs with high voltages would improve the economy, the temperature in the arc being thereby raised. Fig. 1 gives some information on the energy-flow distributed in the spectrum of the arc obtained between impregnated flame-arc electrodes for yellow light. The abscissas are wavelengths, while the ordinates represent the number of times by which the intensity of the light of any particular wavelength in the arc is greater than the intensity in the spectrum of the carbon incandescent lamp. The dotted line represents the sensibility curve of the human eye. It will be seen that special importance is attached to the two strong bands in yellow-green and in orange to which the increasing efficiency of the arc over the incandescent lamp is due. To increase the efficiency further it is of importance that the salts which are used for the impregnation of the electrodes should be able to assume the high temperature of the arc in order to contribute to the light emission. It is suggested to use for this purpose such metals or chemical compounds as are now employed for modern metallic-filament lamps. As a matter of fact electrodes impregnated with such materials give a much higher efficiency than electrodes which contain only the salts formerly employed. The proportions in which the additions are made are, however, also of great importance. If zirconium oxide is added to magnetite, the efficiency of the magnetite arc is increased up to a content of 50 per cent; if the amount of zirconium oxide is increased above 50 per cent the efficiency decreases. It is similar with uranium oxide. The titanium oxide improves the efficiency in such a way that it is the higher the greater the addition, so that the maximum efficiency would be obtained with 100 per cent, but the use of electrodes of pure titanium oxide involves practical difficulties which can be avoided only by suitable additions, although the efficiency is thereby decreased.—*Elek. Zeit.*, March 21, 1912.

Condensers for Metallic-Filament Lamps.—An article on the system of A. W. Ashton for the use of condensers in connection with low-voltage metallic-filament lamps operated from a higher voltage alternating-current circuit. The system has already been described repeatedly in the *Digest*. Some practical notes are given on the two systems

of employing condensers, namely, the parallel system and the series system. The parallel system, which is shown in Fig. 2, is easily applied to houses already wired and can be adapted to any number of single lamps or groups of lamps as may be convenient, and lamps not arranged for control by a condenser would be connected up so as to work at the

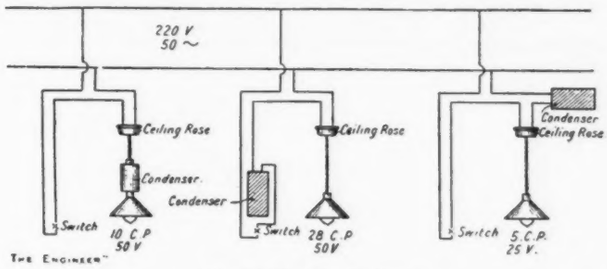


Fig. 2—Parallel System.

full supply voltage. The flexibility of the system is such that it can be applied to those points where the greatest saving can be effected—that is to say, where low-candle-power lamps are sufficient—without interference with those points where high-candle-power lamps suitable for the full pressure of the supply are necessary. In Fig. 2 the arrangement on the left shows a cylindrical condenser with an adapter, as applied without any alteration to the existing wiring scheme. The pressure across the mains might be, say, 220 volts, at a frequency of 25 cycles per second, while the first lamp might be constructed for 50 volts and 10 cp. In the arrangement shown in the middle of the diagram a rectangular condenser is fixed to the wall. Here then may be used a 50-volt, 28-cp lamp. In the arrangement shown on the right of the diagram a rectangular condenser is fixed between the ceiling and the upper floor over the ceiling rosette. The lamp in this instance might be for 25 volts and 5 cp. In each case a different condenser would, of course, be necessary. The series system is shown in Fig. 3, and in it all the lamps are connected in series with each other and with a condenser. Switches are connected in parallel with the lamps, so that when a switch is closed the corresponding lamp is short-circuited. It can be shown that if the sum of the voltages of the lamps in use at the same time does not exceed 40 per cent of the supply voltage, each lamp practically gets its correct current, however many lamps are switched on. In Fig. 3 the first lamp on the left is provided with an ordinary switch. This lamp, for example, might be a 10-cp, 10-volt lamp. The other four lamps in this particular case are arranged for special switch lamp-holders, which short-circuit the terminals of the respective lamps when it becomes necessary to extinguish any particular one. Taking the last four lamps from left to right, these might be for the following voltages and candle-powers: (1) 16 cp, 16 volts; (2) 25 cp, 25 volts; (3) 25 cp,

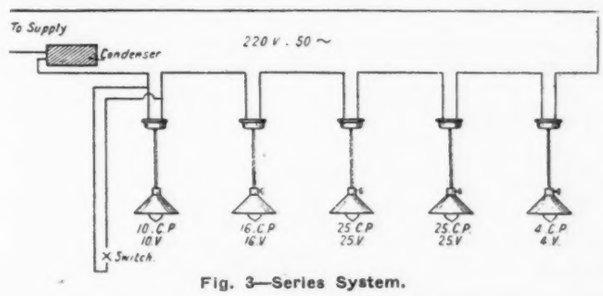


Fig. 3—Series System.

25 volts, and (4) 4 cp, 4 volts. It will be seen that all the five lamps take the same current. It is important to note that in the case of the series system all the lamps, as well as the condenser, must be rated at the same current. The sum of the voltage of all the lamps which are alight at the same time must not be greater than 40 per cent of the supply of the voltage; but, as in most cases all the lamps are not in use at the same time, the total voltage of all the lamps in series may usually amount to 60 per cent of the supply voltage.—*The Engineer* (London), March 22, 1912.

Electric Street Lamp-Posts.—An article illustrated by diagrams on artistic street-lamp standards, giving details of styles, illuminating values, materials, dimensions, etc.—London *Elec. Review*, March 22, 1912.

Generation, Transmission and Distribution.

Diesel Engine.—R. Diesel.—An abstract of a paper before the British Institution of Mechanical Engineers. The author first emphasized the higher thermal efficiency attainable by this engine than by any other, reaching an indicated efficiency of 48 per cent and a brake efficiency of 35 per cent of the heat value of the fuel. He referred to comparative tests of steam engines with oil-fired boilers and Diesel engines, showing that the former required two and one-half times as much fuel as the latter. The world's production of crude oil is at present increasing three and one-half times as rapidly as that of coal, and even with the present production the number of Diesel engines now working can be increased a hundredfold. There are also other fuels than natural mineral oils that are suitable, including tar oils, obtained from coal distillation, which provide an even more economical way of obtaining energy from coal than by burning it under the boilers. Some kinds of brown coal can be used in the same way, and even animal and vegetable oils have been used with success. After these general considerations, the author gave a detailed historical summary of the development of the Diesel engine, from the first experimental engine of 1898 to the large modern two-stroke and four-stroke cycle vertical and horizontal engines made by the leading Continental European firms for both stationary and marine work, which embrace a good deal of diversity in design. At present it is generally agreed that the four-stroke cycle engine of from 5 hp up to 600 hp may be regarded as the exclusive type for stationary plants, but it will probably not remain so much longer, in spite of its perfection, in view of the development of the two-stroke cycle engine, especially that of the double-acting type. Although the two-stroke cycle engine may never equal the four-stroke cycle engine as regards thermal efficiency, its initial cost is so much lower that its slightly higher fuel consumption will be more than counterbalanced by lower capital charge.—Abstracts in London *Electrician*, March 22; London *Elec. Eng'ing*, March 21, 1912. The first part of the full profusely illustrated paper is published in *The Engineer* (London), March 22, 1912.

Choice of Auxiliary Plant for Power Stations.—A. H. Finch.—A paper presented before the Northeast Coast Institution of Engineers and Shipbuilders, in which the author gives some general considerations on the simplification of the auxiliary plant of power stations and the best method of driving the auxiliaries. The following services may with advantage be electrically operated: Mechanical stokers; fans (variable-speed motors being desirable here, if efficient at low speeds); water-service pumps of all sorts except those very rarely used where steam ejectors can be employed; economizer scrapers; coal and ash handling plant; cranes. The following should, where possible, be steam-driven: Feed pumps and combined air and circulating pumps for the condensers. Exciters should preferably be directly attached to the shafts of their generators. Ventilation of alternators should be effected by fans on the rotors. Switches should be electrically operated. Large valves, where speed of operation is essential, may be operated either electrically or, if the station is on a large enough scale to warrant a supply of compressed air always available for cleaning electrical apparatus and driving pneumatic tools, by air. A table is given showing the aggregate auxiliary power installed at various British stations, and in a second table an analysis is given of the power used for various

purposes at these stations.—London *Electrician,* March 22, 1912.

French Water Power Plants.—H. Bresson.—In three former articles the author has given statistical data on the water-power plants of the Loire district (*La Revue Elec.,* Feb. 15, 1908), in the Seine district (the same journal, Jan. 15, 1909), and in the Rhone district (the same journal, Dec. 8, 1911). He now takes up the water-power plants in the rest of France, that is along the coast and along the frontiers. The present statistical tables refer to some 220 plants. A map is added.—*La Revue Elec.,* March 22, 1912.

Unipolar Gear.—H. Breslauer.—An article on various applications of the author's unipolar speed-changing gear (recently described in the *Digest*) for traction purposes, aboard ship, for hauling machines in mines, for rolling mills, in the textile and paper industry, in automobile factories, and in connection with machine tools.—*La Lumière Elec.,* March 16, 1912.

Separating Oil from Water.—An article on tests of oil for lubricating purposes and on the Massip machine for separating oil from the exhaust steam from steam engines. —*La Lumière Elec.,* March 16, 1912.

Electric Power at Dock.—The first part of an illustrated description of the use of electrical power at the new Immingham Dock of the Great Central Railway Company. The power station contains two 250-kw and one 500-kw turbo-generator which generate three-phase currents at 6600 volts with a frequency of 50 cycles. These are converted to direct current before being used for lighting and traction.—London *Electrician,* March 22, 1912.

Electric Power in Shipbuilding.—An illustrated article on electric power in a Japanese shipbuilding yard, namely, that of the Mitsu Bishi dockyard and engine works.—London *Elec. Review,* March 15, 1912.

Installations, Systems and Appliances.

Domestic Rates for Electrical Energy.—W. W. Lackie.—The conclusion of his paper read before the (British) Institution of Electrical Engineers on tariffs for electrical energy with particular reference to domestic rates. The author describes a scheme which enables the domestic consumer to get a supply of electricity for heating, cooking, etc., at a low rate without being put to the expense of separate wiring, with a separate meter, etc. An analysis of between 500 and 600 purely domestic lighting accounts was made by the author for his station, and the average number of units was noted for houses of one, two, three, four, five and six rooms and kitchen, and for large private residences. These were also classified according to district. It was demonstrated that houses with four rooms and kitchen, of the same size as regards cubical contents, were, on the whole, consistent in their general consumption of electricity for lighting purposes. As there were reasons for believing that many of these consumers would use electric radiators, vacuum cleaners, electric irons, etc., if it could be shown that this could be done without initial expense or relatively large outlay, it seemed desirable to meet such cases by a method of charging which would give them their heating and motor-service energy at a lower rate. Having ascertained that domestic consumers' premises similarly situated and of the same size were practically consistent from month to month in the nature and extent of their consumption for lighting, it was a simple matter to devise an adaptation of the maximum-demand system which would meet their case. As their average use of the lighting maximum demand is 800 hours per year and the charge is 6 cents per kw-hr., it was suggested that all energy consumed over this quantity should be charged at 2 cents per kw-hr. In order to enable the consumers to realize that they were getting their extra kilowatt-hours at the lower rate, a proportionate number of lighting kilowatt-hours was allocated to each of the two-month bills, and whatever number of kilowatt-hours might be consumed over this minimum in each two months was to be charged at 2 cents per kw-hr. The division of the 800 hours' use of the maximum demand over the six periods into which the year is divided was as follows:

	Hours' Use of Maximum Demand at 6 Cents.
June–July	40
August–September	60
October–November	200
December–January	300
February–March	160
April–May	40
Total	800
All additional kilowatt hours at 2 cents.	

The number of hours given corresponds to the hours of darkness from sundown to 10 p. m. each two months, and it was found that the domestic consumers' accounts also gave approximately this result. During one year's use this system has proved quite satisfactory in increasing the revenue. It is believed to be better than a literal application of the maximum-demand system. An account of the extensive discussion which followed is also given. This and another recent paper on rates are part of an extensive propaganda of the (British) Institution of Electrical Engineers to encourage the use of electricity for domestic purposes.—London *Electrician,* March 15, 1912.

France.—An article giving statistical data on the import and export trade of France in the year 1911 with special reference to the electrical industry. There is now invested in France $30,000,000 in factories for electrical machinery (with 15,000 workingmen), $10,000,000 in wire and cable factories (with 5000 workingmen), $4,000,000 in factories for telegraph and telephone apparatus (with 3000 workingmen), and $4,000,000 in storage-battery factories (with 4000 workingmen). The value of the yearly products of these four industries is $15,000,000, $10,000,000, $2,000,000 and $4,000,000, respectively; $160,000,000 is invested in electric supply stations. Not less than $100,000,000 is invested in the numerous electrochemical and electrometallurgical plants in France.—*Elek. Zeit.,* March 21, 1912.

Electrical Industry in Germany.—The first part of a statistical article on the commercial position of the German electrical industry in 1911. The general commercial situation in Germany in 1911 is first discussed, and it is shown that the output of the industries has increased, but that the cost of the raw materials used by the industries is also higher than before. The article is to be concluded.—*Elek. Zeit.,* March 21, 1912.

Agricultural Uses of Electricity.—Holldack.—An illustrated article in which the author discusses the difficulties in using electric power for agricultural purposes. Transportable motors are often suitable, and the author recommends carrying out their design so as to produce a practical and rather inexpensive type of motor. For the use of electric power in the field the conditions are rather difficult, since the construction of the line involves difficulties. Electric plows have had considerable competition in recent years from engine-driven plows.—*Elek. Zeit.,* March 21, 1912.

A Large Electric Kitchen.—A description of an electric kitchen installation in a factory in London. Its capacity is for about 1000 persons. Electrical energy is supplied at 1.5 cents per kw-hr. in the summer and 2 cents per kw-hr. during the winter. The whole outfit represents a maximum load of about 160 kw and comprises electric ovens, hot cupboards, tea urns, electrically heated steam boilers and hot plates. When cooking for about 400 persons the energy consumption of the whole equipment is from 120 kw-hr. to 130 kw-hr. per day. During the six months that the installation has been at work, not a single heating element of the equipment has failed.—London *Elec. Eng'ing,* March 21, 1912.

Wires, Wiring and Conduits.

Earthing Through Choke Coils.—A note on a recent British patent (No. 16,907, March 14, 1912) of the Siemens Brothers Dynamo Works, Ltd. (Siemens-Schuckert Company of Germany). In three-phase systems where the lines are earthed through choke coils with a common iron core it is possible for one coil to be damaged by excessive current, as it may be short-circuited when a lead becomes earthed. To avoid this an additional iron limb is provided, which normally carries no flux, but on a lead becoming earthed the flux from the enearthed coils has a path through this limb as well as through the limb of the short-circuited coil. The arrangement may also be used to indicate faulty insulation and for indicating the voltage between high-tension lines.—Lond. *Elec. Eng'ing*, March 21, 1912.

Modern Fuses.—W. Klement.—An illustrated article on various designs of modern fuses.—*Elek. Zeit.*, March 21, 1912.

Electrophysics and Magnetism.

Discharge of Electricity from Points in Gases.—Edward J. Moore.—An account of an experimental investigation of the reaction effects produced by the discharge of electricity from points in gases and the bearing of these effects on the theory of the small ion. The relation between the force of reaction and the distance between the point and plane in point of discharge was investigated and found to be linear within the range of currents and distances used. The relation between the force and the current for different values of the distance was also found to be linear. The absolute values of the velocities of the ions in unit field were found to be very much higher than those obtained by other methods. The ratio of the velocities, however, is only slightly higher. The variation of the mobility with pressure was measured from 760 mm to 5 mm pressure in air, hydrogen and CO_2. The mobility of the positive ion was found to be inversely proportional to the pressure in all cases down to 5 mm. The negative ion shows a rapid decrease in mobility, beyond that required by the law PK = constant, beginning at about 20 cm (K being the mobility and P the pressure). Below 10 cm the mobility becomes very large. In the case of hydrogen these effects occur at somewhat higher pressures.—*Phys. Review*, February, 1912.

Electric Steel Furnace.—W. Lipin.—A long illustrated description of the Nathusius electric furnace which is in use in a steel works in Germany. The Nathusius type is a combination of the Heroult type and the Girod type, but embodies also a third novel feature, that is, the particular method of heating the furnace from the bottom. The Nathusius furnace is, therefore, a combined arc and resistance furnace. Fig. 4 shows the principle of the furnace in its simplest form. The horizontal section through the hearth is circular. From the top are suspended three carbon electrodes the lower terminals being near the slag layer, as in the Heroult furnace. Three steel electrodes are embedded in the bottom of the hearth. They do not pass, however, all the way through the bottom up to the metallic bath, but only to about the center of the height of the rammed dolomite bottom, so that their upper end surfaces are covered with a layer of dolomite. The bottom becomes conducting when the furnace has been heated up. Drawings are given of the construction and data of the operation of the furnace, the chemistry of the refining process and first cost.—*Met & Chem. Eng'ing*, April, 1912.

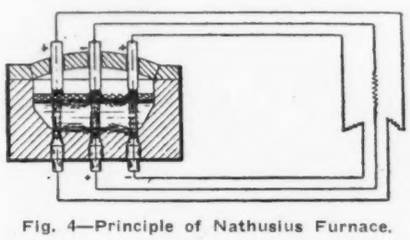


Fig. 4—Principle of Nathusius Furnace.

Units, Measurements and Instruments.

Electrical Testing of Water.—An illustrated description of the Digby-Biggs dionic water tester. The fundamental idea is to substitute a measurement of electric conductivity for chemical analysis and to draw from the conductivity measurement conclusions on the amount of impurities in the water. It can be applied to measure hardness in water, leakage of cooling water into surface condensers, sewage pollution in rivers, minute traces of impurities in distilled water, the priming of steam boilers, etc. Conductivity measurements do not discriminate between one kind of foreign substance in the water and another; analysis alone can do that. But in most instances in which water testing is carried out for engineering purposes the substance present in the water is known, having been ascertained once for all by analysis or being inherent in the source of supply. Further tests are then not made for purposes of analysis, but to find out how much of the known substance is present in the water; and in all these cases the dionic tester gives the required answer with a rapidity and simplicity unapproached by any chemical test. The water to be tested is contained in a U-tube and connection is made to a direct-reaching conductivity meter and a hand-driven generator.—*Met. and Chem. Eng'ing*, April, 1912.

Telegraphy, Telephony and Signals.

Undamped Electrical Oscillations.—A note on a method of E. L. Chaffee for producing undamped electrical oscillations of extremely high frequency with great regularity. In principle the method stands intermediate between those of Poulsen and Wien. A continuous-current generator giving 530 volts is connected through variable resistances and inductances and through the primary coil of a closely coupled oscillation transformer to the oscillation gap. This consists of two parallel plates of 1 or 2 sq. cm area, 0.07 mm apart, the anode being of copper or silver and the cathode of aluminum. Both anode and cathode are water-cooled or air-cooled, and are surrounded by moist hydrogen at atmospheric pressure. The primary of the transformer and the spark-gap are shunted by an air condenser, and another is placed in series with the secondary of the transformer. Both admit of variation to secure syntony.—London *Electrician*, March 15, 1912.

Book Review

Annuaire du Bureau des Longitudes. Paris: Gauthier-Villars. 692 pages. Price, 1f. 50c.

This delightful little pink book, annually springing from the Gauthier-Villars press to give expression to officially scientific Paris, is before us for the current year. It opens with the significant and important notice that the legal time of France and Algeria is behind the mean time of Paris by nine minutes and twenty-one seconds. By another significant coincidence the meridian so determined is that of Greenwich. When the British, in utter weariness of metrological chaos, adopt the international metric system, we may hope to see the meridian of France called the meridian of Greenwich. This year's Annuaire devotes about one-half of its pages to calendrical and astronomical data, the other half being given to physics and chemistry. Two important appendixes deal respectively with the mean temperature of France and with the principles of "least squares." The book is as valuable statistically and scientifically as it is inexpensive. No other extensive important official scientific publication has been placed upon the market at so low a price.

New Apparatus and Appliances

FORT WAYNE AGENTS' CONVENTION.

On March 25 to 29 inclusive a convention was held of the sales agents of the Fort Wayne electric works of the General Electric Company at the home office at Fort Wayne, Ind. There were present about seventy-five of the salesmen, including the managers of all the district offices of the company. The business of the convention was given over largely to illustrated lectures and discussions covering the commercial, and as well the manufacturing, side of all the company's product. On Wednesday evening of the convention there was held at the Elks' Temple a banquet and rejuvenation of the Sons of Jove, at which forty candidates were initiated. The convention closed with an elaborate banquet at which covers were placed for 112 guests.

INSULATOR CLAMPS.

The clamps manufactured by the Clark Electric & Manufacturing Company, New York City, some of which are illustrated herewith, are intended for use in place of tie wires for fastening conductors to insulators and, being especially designed for that service, naturally possess advantages over the tie wire. Clamps for attaching conductors to pin-type insulators are now in use on many important lines, so that the scheme is by no means new. The clamps may be quickly fastened in place, it is claimed, by even unskilled labor, and the time required to make a satisfactory tie is stated to be much greater than that required to bolt a clamp. The clamps are supplied of suitable types for use in connection with either straight-line work or at points where the direction of the line changes. They may be furnished to provide either very rigid or flexible construction, as may be desired, to meet the existing conditions.

For electrolytic reasons, the manufacturer claims it is best to use clamps made of red bronze, if the conductor is bare copper, or of galvanized or sherardized malleable iron, when bare steel or aluminum or insulated conductor is used. Bushings of soft copper, aluminum or lead may be provided to wrap around the conductor at the clamp, to protect it or the conductor insulation from any possible abrasion.

Fig. 1 shows a clamp of light weight and permitting flexible construction, which tests are said to show will withstand a high line, side or vertical pull. Fig. 2 shows a clamp providing rigid construction and largely used on the steel messenger lines of the Southern Pacific Company. Fig. 4 shows a type of clamp well suited for use with bushings. When a very severe line pull is to be met a clamp combining the features of those shown in Figs. 2 and 4 may be supplied. Such clamps will withstand a line pull of 6000 lb. or more and are used extensively in overhead clamping sets at railroad right-of-way. Fig. 5 shows one type of angle clamp for use where the line direction changes. This type may be supplied for changes in line direction up to 90 deg. or more. Fig. 3 shows a standard street arc circuit clamp for holding street arc-lamp cables to standard pole insulators. It is fitted with lead bushings to protect the cable insulation. The clamp may also be used to fasten vertical busbars in place. It is made of either red bronze or malleable iron protected by a coating of zinc, with copper plated or sherardized bolts and nuts, as may be desired.

Fig. 2—Clamp for Small Indicators.

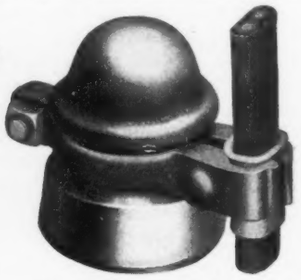


Fig. 3—Clamp for Arc-Lamp Circuit.

MULTI-COLOR LAMP FOR ADVERTISING PURPOSES.

A form of lamp suitable for outside advertising for cinematograph theaters, music halls, restaurants, shops, etc., is marketed by the Armorduct Manufacturing Company, Ltd., 6 Farrington Avenue, London, England, and has received the trade name of "Rainbo." In general appearance this lantern resembles an arc lamp. It is fitted with an opal globe, inside of which are three metallic-filament lamps of 25 cp, with red, blue and yellow globes respectively. Inside of the case and immediately above the lamp holders are three thermo-flashers with adjustable platinum contact points set to connect the lamps in and out of circuit and in such a way that either one, two or three are alight. With two or three lamps lighted different combinations of color are produced, which are evenly diffused with the globe. With one lamp, of course, the particular color of the bulb is shown. Inasmuch as the flashers are not synchronized, the colors are constantly changed. The combination is neat and substantial and the lantern is weatherproof. The energy consumption is said to be 1 kw in six hours. The color changes obtained by the lamp are attractive, and the absence of revolving mechanism and noise adds to its effectiveness.

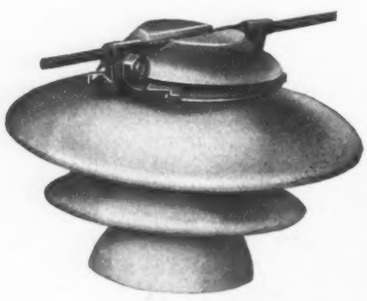


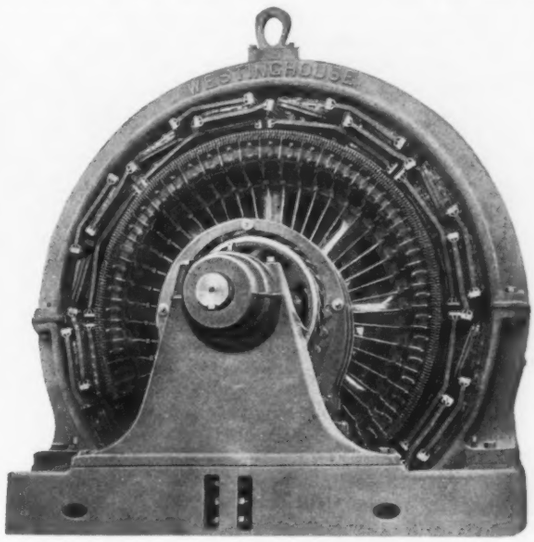
Fig. 1—Standard Insulator Clamp.

Fig. 4—Clamp for Small Insulator.

Fig. 5—Angle Insulator Clamp.

LARGE COMMUTATING-POLE SYNCHRONOUS CONVERTER.

The accompanying illustration shows a 7500-kw synchronous converter recently installed in a substation of the Interborough Rapid Transit Company, New York, where it occupies only a little more floor area than was covered by an older type of 1500-kw converter used by the company formerly. The converter is a six-phase, 25-cycle machine designed for 600 volts. It is equipped with commutating poles and has carried successfully as great a load as 10,000 kw. It was built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.



Commutating-Pole Synchronous Converter.

SMALL PENDENT SWITCH.

In the pendent switch just placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., the brass shell, fashioned like an acorn, is a trifle over 1¾ in. in height and a single switch weighs less than 2 ounces. These advantages have been attained without sacrifice of serviceability. Removal of the cap (which is held in place by a snap lock) reveals a simple but rugged interior mechanism operated by a straight push-bar, similar to that used in Cutler-Hammer porcelain pendent switches. Ample terminal space is provided for wiring, and the Underwriters' label testifies to the fact that the new switch has successfully met the rigid requirements of the Underwriters' Laboratories.

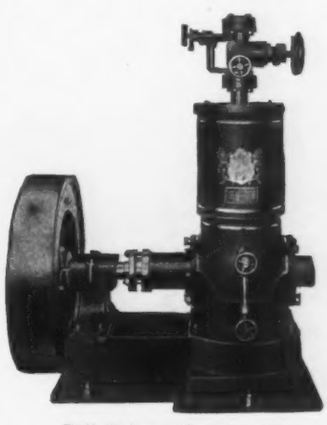
The "Acorn" switch operates with a quick snap, and the whole of the operating mechanism, except the projecting push-buttons, may be concealed under a half-dollar. No porcelain is used in the construction of this switch, a new insulating material, developed in the ceramic laboratory of the Cutler-Hammer Manufacturing Company, being used for supporting the operating mechanism. This new material is said to be unbreakable under ordinary service conditions, and can be molded with much greater accuracy than porcelain, insuring proper alignment of parts and smoother operation when the switch is assembled. The brass cap is designed to be snapped on to the shell, and is provided with a hard-rubber bushing which accommodates either standard or reinforced flexible cord. In spite of its small size the new switch has the usual ampere capacity for snap switches, being rated at 6 amp, 125 volts, or 3 amp, 250 volts.

Small Pendent Switch.

ICE MAKING BY CENTRAL STATIONS.

Much attention has been paid by central stations in the last few years to the subject of making ice as a by-product. the demand for ice is greatest during the summer months, and this is just the time when the greater proportion of the central-station equipment is unused. In many cases central-station profits have been greatly increased by adding to the revenue from the sale of electricity the return from ice making. The Baker Ice Machine Company, of Omaha, Neb., has made a special study of this subject for several years, and it manufactures an ice-making plant especially adapted for operation in connection with electric-service stations.

The ice-making machinery of the company named is usually installed so that the compressor and brine-circulating apparatus may be operated by electric motors. The cooling of the brine for ice making is done by means of a patented flooded-type cooler which is usually located along the wall of the ice-storage room. This eliminates the use of coils in the ice-making tank, the brine being taken from this tank by means of a large centrifugal pump and passing through the cooler and back to the opposite end of the ice-making tank. Where exhaust steam is available, it may be condensed so as to obtain distilled water for the manufacture of the ice. Ice-making cans having a capacity of 300 lb. each are usually used, and the ice-making tank should contain at least sixteen of these cans for each ton of ice that is to be drawn every twenty-four hours.



Belt-Driven Compressor.

In the accompanying illustration is shown the belt-driven type of compressor made by the Baker company. The ice-making machinery of this company has been designed to be as nearly automatic as possible, and the pulling of the

ice is nearly all the labor required. As shown in the illustration, the compressor is of the inclosed type, having two cylinders, single-acting. By the use of this machine the packing of the piston rods is eliminated and at the same time external oiling devices are done away with, as the compressor runs in oil. The floor space taken up by the compressor is reduced to a minimum, and the valves are so arranged that they are readily accessible for examination without interfering with any other part of the machine.

HIGH-SPEED, UNIFLOW STEAM ENGINE.

About three years ago Messrs. Browett, Lindley & Company, of Manchester, England, after careful examination of the "uniflow" type of engine, decided to develop a high-speed engine on that principle. Fig. 1 shows the engine built for demonstration purposes, which, when tested under 147 lb. steam pressure, superheated 100 deg. and exhausting into a vacuum of 26 in., gave a steam consumption of 12.8 lb. per brake-hp-hr.

In this type of engine the steam always flows in one direction from the inlet to the exhaust, there being an inlet valve at each end of the cylinder and the exhaust taking place when the piston uncovers the ports in the center of the cylinder barrel when nearing the end of its stroke. Fig. 2 shows a section through the cylinder and valves of the engine.

The piston is shown at the top of its stroke. The inlet valve is therefore just commencing to admit steam and the bottom side of the cylinder is full open to exhaust. The inlet valve is a combined piston and drop valve, giving quick cut-off. In Fig. 3 the valve is shown just on the point of shutting off steam. At this position it is closing

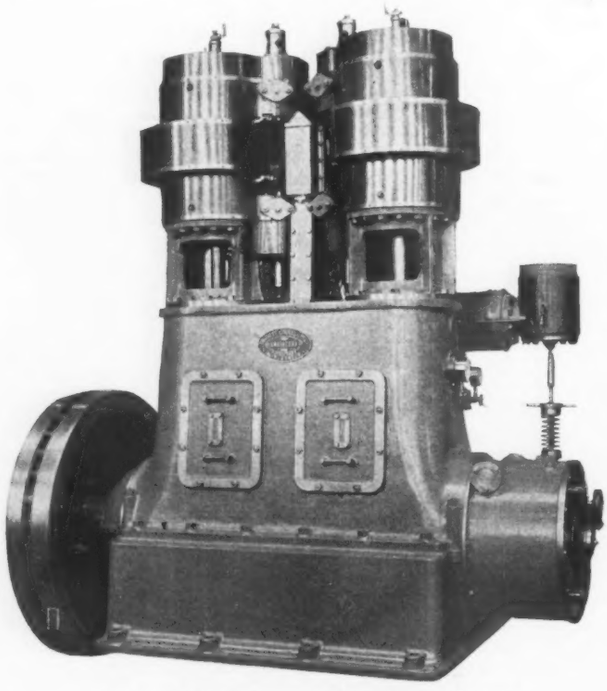


Fig. 1—High-Speed, Uniflow Steam Engine.

rapidly, but the cams operating the valves are so designed that the remainder of the travel takes place gradually. This prevents hammering of the valves on their seats. A small quantity of steam inclosed between the valve and the seat cushions the valve, and by this means it is possible to operate it quite silently at high speeds.

Referring to the end view, it will be seen that the valve gear consists of a double-ended cam *A* mounted on a rocking shaft *B*. This shaft, together with the cam, is oscillated by means of the lever *C* and eccentric rod *E* in the usual way. Three rollers *F* are mounted at the end of a spring lever *G*. The two outside rollers rest on the cam, while a center roller is in contact with the valve spindle. It will thus be seen that the center roller relieves the valve spindle of any slight side pressure which might be exerted owing to

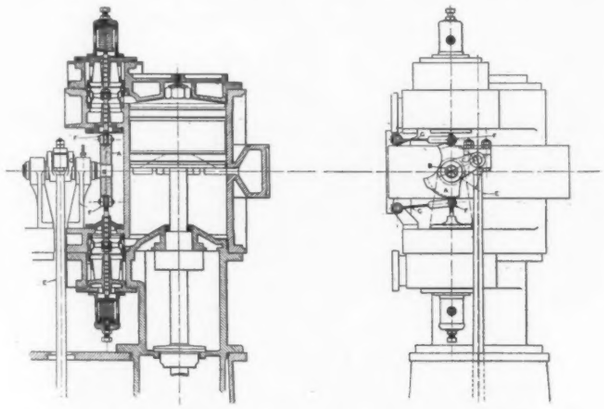


Fig. 2—Sectional View and Valves of Engine.

the versed sine of the arc through which the spring lever *G* moves.

Again referring to the drawing, it will be seen that the raised portion of the cam is just commencing to lift the top valve, while the bottom valve is closed. When the rollers are in this latter position there is a very slight clearance between the roller and the valve spindle, but this small clearance, about 1-500 in., is gradually taken up as the cam works over to the position where it commences to lift the valve. By this means the valves are enabled to remain on their seats during the period they require to be closed,

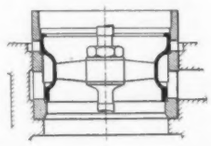


Fig. 3—Enlarged View of the Valve and Seat.

and they are lifted without noise as the roller is very gradually brought into contact with the valve spindle.

The valve gear is of simple construction and all the working parts are lubricated by oil under pressure. The valves are always pressed toward their closed position by the light springs shown at the opposite ends of the valve gear. These springs are outside the cylinder.

The pistons and valves of this engine are quite as accessible as the pistons and valves of ordinary piston valve engines. To remove a valve it is only necessary to remove the cover and the valve, together with its spindle, can

Fig. 4—Indicator Diagrams.

immediately be withdrawn. The piston can be withdrawn in the usual way. Indicator diagrams are shown in Fig. 4.

The engines are built in sizes ranging from 25 hp upward, and they can be run at speeds from 100 to 500 r.p.m. The engine, it is claimed, possesses the advantage of maintaining its economy over a large range of load and will work under all ordinary conditions as regards vacuum without rapidly increasing consumption.

Industrial and Commercial News

UNFILLED orders on the books of the United States Steel Corporation as of March 31 amounted to 5,304,841 tons, a decrease of 149,359 tons as compared with the February figures. Throughout the iron and steel industry, however, operations and inquiries at present are full of promise, and the improvement in activity is regarded by many as an indication of improvement along general lines. Business with the equipment companies is somewhat better than in recent weeks, and the steadiness with which orders are being received by the leading electrical manufacturers points toward expansion throughout the country. Settlement of the differences in the anthracite fields will, it is expected, be made through revival of a strike commission empowered to draw up a new working agreement between operators and miners. The trade situation in general shows that advancement is being made. Rates in the money market, April 10, were: Call, 3½ @ 4 per cent; ninety days, 3¾@4 per cent.

THE COPPER MARKET.

The March statement of the Copper Producers' Association, issued on April 9, showed a decrease of 572,431 lb. in surplus stocks of refined copper during that month. Production in March was 125,694,601 lb., as compared with 116,035,809 lb. in February, and total deliveries were 126,267,032 lb., as compared with 119,376,464 lb. in the previous month. Export deliveries were 58,779,566 lb., as compared with 63,148,096 lb. in February, while domestic deliveries increased from 56,228,368 lb. in February to 67,487,466 lb. in March. Stocks on hand at the end of the month were 62,367,557 lb, comparing with 62,939,988 lb. at the end of February. Demand for copper has not been especially active during the week, and prices for electrolytic are still nominally 15⅞ cents per pound. Actual sales at 16 cents, reached last week, were in very small volume, indicating that purchases were made at this figure in only exceptional cases and that maintenance of the higher levels will restrict consumption. Exports thus far in the month, including April 10, amount to 7452 tons. The daily call on the New York Metal Exchange, April 10, quoted copper as per the accompanying table.

Standard.	Bid.	Asked.	Settling Price.
Spot	15.37½	15.50	....
April	15.45	15.60	15.52½
May	15.47½	15.55	15.52½
June	15.47½	15.60	15.55
July	15.47½	15.70	15.60

The London market, April 10, was as follows:

	Noon. £	s	d	Closing. £	s	d
Standard copper, spot	70	1	3	69	6	3
Standard copper, futures	70	18	9	70	3	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	15.62½c.			13.65c.		
London, spot	£71	0	0	£60	16	3
London, futures	72	2	6	61	10	0
Best selected	75	5	0	65	5	0

INDUSTRIAL AND COMMERCIAL NOTES.

Traveling Marine Exposition Project Revived.—The United States Marine Exposition Company, a corporation organized under the laws of the State of New York, subsidiary to and under the patronage of the American Manufacturers' Export Association, which comprises more than 300 of the leading exporters in the United States, has made arrangements for the purchase and remodeling of a steamship of 12,185 tons, 580 ft. long and of 60-ft. beam, with which it will provide a permanent and annual exposition, to be fitted out with exhibits of finished products manufactured in this country, and sent as a trade emissary into every important port of the West Indies, Central and South America, and then to the Far East. A similar project was planned several years ago, but was not carried out. The steamer will be named *Exposition*, and the first cruise will leave the port of New York on or about Nov. 1, 1912. The vessel will carry more than 1200 individual exhibits of practically every class of up-to-date products of American factories. The first trip will cover 180 days, of which it is estimated 70 days will be the steaming time and 110 days will be spent in various ports. The itinerary as fixed includes stops at forty ports along the east and west coasts of Central and South America and the West Indies, starting from New York Harbor and ending at San Francisco, Cal. According to representatives of the company, a number of the leading electrical manufacturers have displayed a high degree of interest in the enterprise and have requested data. Henry T. Wills is general manager of the exposition company, John J. Finnell exposition manager and Wendall B. Campbell chairman of the executive committee. The offices of the company are at 200 Fifth Avenue, New York.

Change of Names of Lamp Manufacturers in National Electric Lamp Association.—As has previously been noted in these columns, the properties of the constituent companies of the National Electric Lamp Association have been transferred to the General Electric Company in accordance with the plan for readjusting the incandescent-lamp business to conform with the provisions of the decree entered in the United States Circuit Court, Northern District of Ohio, Eastern Division, Oct. 12, 1911, in the suit of the government against the incandescent-lamp manufacturers, and these companies are now conducting their business as part of the General Electric Company. For establishing this affiliation, in the cases of the Banner Electric Company, Brilliant Electric Company, Buckeye Electric Company, Colonial Electric Company, Columbia Incandescent Lamp Company, Fostoria Incandescent Lamp Company, General Incandescent Lamp Company and Sunbeam Incandescent Lamp Company, the word "Company" has been dropped from the old title and the words "Works of the General Electric Company" added. Thus, the Banner Electric Company is now the Banner Electric Works of the General Electric Company. The names of the other companies in the association have been changed as follows: New York & Ohio Company to Packard Lamp Works of the General Electric Company; Sterling Electric Manufacturing Company to Sterling Electric Lamp Works of the General Electric Company; Bryan-Marsh Company to Bryan-Marsh Electric Works of the General Electric Company; Warren Electric & Specialty Company to Peerless Lamp Works of the General Electric Company, and Shelby Electric Manufacturing Company to Shelby Electric Lamp Works of the General Electric Company.

Annual Meeting of Western Electric Company.—At the annual meeting of the stockholders of the Western Electric Company, held in Chicago on April 4, President Thayer presented his annual report, which had been made public previously and which was summarized in the *Electrical World* of March 30, page 710. U. N. Bethell, of New York, was elected a director in place of F. R. Welles. With this exception all the old directors and officers were re-elected. Sales of the Western Electric Company in March were about equal to those in March, 1911, and the record of the first quarter of the year shows sales at a rate of about $67,000,000 for the year, as compared with $66,200,000 in 1911. Orders on hand April 1 were about $50,000 larger than last year. Foreign business also shows expansion, attributed chiefly to receipts of several very large contracts.

List of Boiler Manufacturers.—At the annual convention of the American Boiler Manufacturers' Association, held in New Orleans March 12-15, the secretary of the Supplymen's Association was authorized to publish a list of boiler manufacturers in the United States and Canada. This list comprises 100 names, which have been verified through mercantile agencies and by direct correspondence, and will be of interest to manufacturers of tools used in boiler shops, material men, mechanical engineers and boiler buyers. The book is also arranged with a column in which the credit rating and financial responsibility can be inserted. A copy can be obtained for $5 from F. B. Slocum, secretary Supplymen's Association, care of Continental Iron Works, West and Calyer Streets, Brooklyn, N. Y.

Republic Railway & Light Acquisition.—The Republic Railway & Light Company, No. 60 Broadway, New York, has acquired all the outstanding stock and bonds of the Pennsylvania Power Company, of Elwood City, Pa. This company owns a 1500-hp hydroelectric plant, which it operates in conjunction with a 750-hp steam reserve plant, furnishing energy for light and power purposes to Elwood City and to the boroughs and towns of Wampum, Chewton, Zelienople and West Pittsburgh, Pa., the latter being but 4 miles from Mahoningtown, on the present system of the Republic Railway & Light Company. The Pennsylvania Power Company's system will be immediately connected by a high-voltage transmission line to the Youngstown (Ohio) system of the Republic Railway & Light Company. The hydroelectric plant will be operated night and day in order to secure the maximum output available from the present development. The excess peak requirements of the Pennsylvania Power Company will be furnished by the steam plant of the Republic system at Youngstown, Ohio. Appreciable reduction in the cost of producing energy to the entire system is expected as a result of connection with the Pennsylvania company. The latter has a large amount of new business in sight, which it is expected will be taken on when the service outlined above is offered.

Equipment for Crane Falls Project, Idaho.—Contracts have been awarded to the Allis-Chalmers Company for the following equipment, to be used on the Crane Falls power and irrigation project, Idaho: For three quadruplex open-flume-type hydraulic turbines, each of 3000 b.hp capacity, under a 27-ft. head, at 164 r.p.m.; two single-runner exciter turbines, each of 215 b.hp capacity, under a 27-ft. head, at 350 r.p.m.; three waterwheel-type three-phase, 60-cycle, 6600-volt alternators, at 164 r.p.m., and two 120-kw, 125-volt compound-wound exciters, at 350 r.p.m. Contracts have been placed with the Westinghouse Electric & Manufacturing Company for equipment for the same project as follows: For three single-phase, 60-cycle, 6600-volt to 66,000-volt high-tension step-up transformers; for three single-phase, 60-cycle, 60,000-volt high-tension to 2200-volt low-tension step-down transformers, and for three 1025-hp, 865-r.p.m., two 700-hp, 700-r.p.m., two 330-hp, 495-r.p.m. and two 255-hp, 1150-r.p.m., three-phase, 2200-volt induction motors, with squirel-cage secondaries and complete starting equipment. Messrs. Smith, Kerry & Chace, Toronto, Canada, are the engineers on this work.

A New Kentucky Hydroelectric Company.—Organization of the Dix River Power Company, which will build a large hydroelectric plant on the Dix River, Kentucky, near its confluence with the Kentucky River, has been practically completed. The officers will be: L. B. Herrington, Richmond, Ky., president; Harvey Chenault, Richmond, secretary, and Bethel B. Veech, president of the United States Trust Company, Louisville, treasurer. The company expects to spend $3,000,000 on its plant, which will generate 24,000 hp, and on the construction of transmission lines to Louisville and Lexington, Ky., and Cincinnati, Ohio, as well as to smaller towns near by, such as Stanford, Harrodsburg, Lancaster, Nicholasville and Danville. The plans of the promoters of the project have been known in general for some time, as surveys have been made and data on the feasibility of the proposition secured. Work will probably begin during the current season. A feature of the construction will be a 200-ft. concrete dam across the river near Danville.

Bergmann Electricity Works.—According to cable dispatches from Germany, the Bergmann Electricity Works, the large German electrical company heretofore independent of the Allgemeine Elektricitäts Gesellschaft and the Siemens-Schuckert Company, will be absorbed by the latter concern. The business of last year had been fairly satisfactory and permitted payment of a dividend, although considerably reduced, namely, 5 per cent, instead of 15 per cent. The stumbling block was the necessity of raising fresh capital, and this has now been provided by the Siemens-Schuckert Company and by banks behind this concern. According to the latest cable dispatches it is not yet settled whether Mr. Bergmann will be in the new board of directors. The firm employs about 20,000 workmen.

Progress of Tasmanian Hydroelectric Project.—According to press dispatches, plans for the construction work on the hydroelectric system to be built for Tasmania, Australasia, are going forward satisfactorily. Contracts for the first unit, to develop 9000 hp, and for the transmission line have been entered into with the British Westinghouse Electric & Manufacturing Company, Ltd. It is stated that the water sites are possible of developing over 80,000 hp.

Texas Hydroelectric Developments Planned.—Plans are being made by the Guadalupe Water Power Company, of Seguin, Tex., which was recently organized with a capital stock of $600,000, to construct a series of dams and hydroelectric plants upon the Guadalupe River. Energy from these stations will be used for operating interurban railways between Seguin and New Braunfels and San Antonio.

Aluminum Notes and Prices.—The aluminum market is steady. Prices per pound, in ton lots, April 10, were: No. 1 pure ingot, 19@22 cents; rods and wire, base price, 31 cents, and sheets, 33 cents.

Financial

Tennessee Railway, Light & Power Company Organized.—Negotiations between H. M. Byllesby & Company, Chicago; E. W. Clark & Company, Philadelphia; William P. Bonbright & Company, and Hodenpyl, Hardy & Company, New York, have resulted in the formation of a plan for developing water-power resources in the State of Tennessee and the transmission of energy throughout this State and Kentucky and parts of Georgia. The plan calls for the formation of the Tennessee Railway, Light & Power Company under Maine laws and the Tennessee Power Company under Tennessee laws. The authorized capitalization of the first company will consist of $50,000,000 preferred stock, of which $10,250,000 will be outstanding, and $20,000,000 common stock, all of which will be outstanding. The capitalization of the Tennessee Power Company will consist of $50,000,000 first-mortgage fifty-year 5 per cent gold bonds, dated May 1, 1912, of which $7,500,000 will be outstanding, and of $20,000,000 common stock, all of which will be issued. The Tennessee Railway, Light & Power Company will own the following: All of the capital stock of the Tennessee Power Company (excepting the qualifying shares of the directors); a large majority and probably all of the common stock of the Nashville Railway & Light Company; all the bonds and capital stock (except directors' qualifying shares) of the Cleveland Electric Light Company, of Cleveland, Tenn.; a large majority and probably all of the preferred and common stock of the Chattanooga Railway & Light Company. The company will have approximately $882,000 in its treasury as working capital. The Tennessee Power Company will own, free from all encumbrances (other than its first-mortgage bonds mentioned above), the following properties: The 20,000-hp hydroelectric plant on the Ocoee River at Parksville, Tenn., now in operation; the transmission lines now in use from this plant, by way of Cleveland, to Chattanooga; the transmission line from Cleveland to Knoxville, Tenn., which is nearly completed; the transmission line from Cleveland southward to the Georgia State line; the Great Falls power site and reservoir at the junction of the Caney Fork and Collins Rivers, near Rock Island, Tenn., capable of development of 80,000 hp, and said to be the most desirable water-power site in Tennessee; two additional sites on the Ocoee River, in addition to the first-named above, one capable of development of 16,000 hp and the other of 30,000 hp. The company will have in its treasury $2,478,000, which it is proposed to use for new construction and other corporate purposes. A large part of the properties named above will be acquired by purchase from the Eastern Tennessee Power Company, with the approval of the stockholders of that company. The following construction work will be undertaken immediately by the company: An addition of 15,000 hp to the first development on the Ocoee River, now in operation as above; construction of a 16,000-hp hydroelectric plant on the second site on the Ocoee River, to operate under a 250-ft. head; construction of additional transmission lines from Parksville, by way of Great Falls, to Nashville, Tenn., and from Nashville through the surrounding country, to reach the various power users.

United Wireless Merger.—Announcement has been made by Saul S. Meyers, 60 Wall Street, New York, counsel for the reorganization committee of the United Wireless Telegraph Company, that the last step necessary for consolidation with the Marconi Wireless Telegraph Company of America has been taken. Mr. Meyers appeared before Judge Hale of the United States District Court at Portland, Maine, last week and made an offer on the part of the reorganization committee, of which Arthur P. West, vice-president of the National Surety Company, is chairman. The offer, which was accepted by the trustees and the court, was to pay to the trustees in bankruptcy $650,000 in cash, $100,000 down, $100,000 May 8 and the balance on Dec. 1. The arrangement for consolidation with the Marconi company provides that the stockholders of the United company and of the Marconi company combine their interests, either by the formation of a new company with an authorized capital of $10,000,000 or by increasing the capital of the Marconi Wireless Telegraph Company of America from $1,511,200 to $10,000,000. It is proposed to have the physical assets and patents of the United company turned over to the new company at a valuation of $700,000, to have the assets (including patents and patent rights) of the Marconi Wireless Telegraph Company of America turned over to the new company at a valuation of $1,511,200, and to have the Sir Oliver Lodge American patents turned in by the Marconi Wireless Telegraph Company, Ltd., of London, at a valuation of $788,000.

Roanoke (Va.) Traction & Light Bonds Offered.—Baltimore banking interests are offering $200,000 first-mortgage and collateral-trust 5 per cent gold bonds of the Roanoke Traction & Light Company, due Aug. 1, 1958, at 95 and interest. According to a circular describing the offering, the company owns and controls the street railways and the electric light and power business in and about the city of Roanoke, Va. The authorized bonded debt of the company is $3,000,000, as follows: $1,450,000 outstanding, including the above $200,000; $750,000 reserved to retire $750,000 Roanoke Railway & Electric first-mortgage 5 per cent bonds; $800,000 issuable only for future extensions, etc., at not over 85 per cent of cost. The company has $1,000,000 stock, all of which was purchased by the American Railway Company in 1910. The entire $500,000 stock of the Roanoke Railway & Electric Company is pledged under the mortgage, which also covers all other property owned, including a 4000-hp hydroelectric plant on the Roanoke River, 4½ miles from the city, and a 3000-hp steam plant. Gross earnings of the company in the six months ended Dec. 31, 1911, were $259,219 and net earnings were $128,094.

H. L. Doherty vs. American Gas & Electric Company.—On April 4, before Judge Bischoff, in the Superior Court, Henry L. Doherty sought an injunction against the American Gas & Electric Company, of which he was formerly president and is now a director, to restrain the company from selling $1,000,000 of its common stock until determination of his rights to exercise an option which he claims to hold on this amount of American Gas & Electric stock. Reference to this point of difference was made in these columns March 25 and 30. It was stated to the court that Mr. Doherty was instrumental in reorganization of the Electric Company of America, the outcome of which was the incorporation of the American Gas & Electric Company (on Dec. 20, 1906) with Mr. Doherty as its president. It was contended by Mr. Doherty that the promoters gave him a five-year option on $1,000,000 common stock, under the terms of which he could claim the stock on payment at par. It was stated that when he offered $1,000,000 in January last he was told that he never had such an option. Decision was reserved.

Westinghouse Machine Plan Ready for Adoption.—The financial plan of the Westinghouse Machine Company to increase the capital stock of the company has been completed and now awaits only the formal action of the creditors' committee to be put into effect. The plan provides for the issue of 6 per cent preferred stock and for the reduction of the present bond issue to $7,500,000. Under this plan noteholders are to receive 75 per cent of their claims in 6 per cent first and refunding mortgage bonds, 10 per cent in the new preferred stock and 15 per cent in cash. The preferred stock will be entitled to a preferential dividend of 6 per cent and to a further one-half of 1 per cent for each 1 per cent above 6 per cent paid on the common stock. Since the first of the year the business of the company has been exceedingly gratifying.

Montreal Tramways & Power Sells Notes.—The Montreal Tramways & Power Company has sold $5,000,000 three-year 6 per cent collateral-trust gold notes, dated April 1, 1912, and maturing April 1, 1915, to New York banking interests which offered them for sale this week. The notes are subject to call at 100 and interest on any interest date. They are secured by pledge of $6,000,000 5 per cent debenture stock of the Montreal Tramways Company and additional collateral carrying the voting stock control of companies doing the entire street railway business in Montreal and owning large water-powers on the St. Lawrence River and plants for the distribution of energy for electric light and power purposes in the city of Montreal. This issue will result in the retirement of all floating indebtedness of the company and no further financing is contemplated during the life of these notes.

Allis-Chalmers Receivership.—With a view to expediting the reorganization of the Allis-Chalmers Company D. W. Call, president of the company, and General Otto H. Falk, of Milwaukee, president of the Merchants and Manufacturers' Association, were appointed receivers for the company on April 6. These appointments were made upon application of the First National Bank and the Wisconsin National Bank, of Milwaukee, and W. W. Nichols, a security holder of the company. A member of the stockholders' committee said on April 10 that, although he could not state the exact number of assents to the plan, it seemed certain that it would be carried through successfully.

McCrum-Howell Progress.—A bankers' committee has been appointed to represent the banks in the reorganization of the McCrum-Howell Company, consisting of A. H. Wiggin, president of the Chase National Bank, of New York; Herman Waldeck, vice-president of the Continental Commercial National Bank, of Chicago, and John C. McKeon, vice-president of the National Park Bank, of New York. A stockholders' committee will also be formed, it is understood, to represent shareholders in New York, Boston, Philadelphia, Chicago and St. Louis. The receivers of the company are E. R. Stettinius and W. D. Woodin.

Sedalia (Mo.) Light & Traction Reorganization.—A plan for reorganization of the Sedalia (Mo.) Light & Traction Company has been deposited with the New York Trust Company, as depositary, by the committee representing holders of the Manhattan Trust Company's certificates for the utility company's first-mortgage 5 per cent bonds. Bondholders who have not deposited may yet participate in the plan if they deposit their bonds on or before April 19.

New England Investment & Securities Bill Favored.—The Massachusetts legislative committee on street railways has reported favorably on a bill which was petitioned by the New England Investment & Securities Company, Springfield, Mass., giving the New York, New Haven & Hartford Railroad Company the right to acquire street railway lines in the southern part of the State.

Mount Hood (Ore.) Railway & Power Company Changes Ownership.—The Portland Railway, Light & Power Company, of Portland, Ore., has purchased the Mount Hood Railway & Power Company, of the same city, whose properties include a hydroelectric plant and 20 miles of steam road, the combined valuation of which is placed at about $5,000,000.

Consolidated Gas, Electric Light & Power Debenture Stock Authorized.—The Maryland State Legislature has approved the bill authorizing the Consolidated Gas, Electric Light & Power Company, of Baltimore, to issue debenture stock, to which reference was made in these columns March 2, 1912.

MARKET PRICES.

	April 3.	April 10.		April 3.	April 10.
Allis-Chalmers	1⅞	2	Mackay Companies..	80	84⅜
Allis-Chalmers, pf...	5¾	5½	Mackay Cos., pf....	69⅛	69⅜*
Amalgamated Cop...	82	81⅜	Philadelphia Elec....	18¼	18
Boston Edison 295		291	Western Union.....	83⅛	83
C'monwealth Edison.146		146½	Westinghouse	76	76½
Elec. Storage Bty...	54½	55¼	Westinghouse, pf....122½		122½*
General Electric.....167½		171			

*Last price quoted.

Personal

Sir J. J. Thomson has been appointed by King George V a member of the Order of Merit.

Mr. Frank Conley has been appointed general superintendent of the De Kalb-Sycamore (Ill.) Electric Company, of which he was formerly chief engineer.

Mr. U. N. Bethell, president of the New York Telephone Company, was elected a director of the Western Electric Company, succeeding Mr. F. R. Welles, at the annual meeting in Chicago on Feb. 4.

Mr. Aldis E. Hibner has resigned as power engineer of the Livingstone-Niagara Power Company to accept a position as electrical commercial manager of the Empire Gas & Electric Company, Auburn, N. J.

Mr. Warren Partridge has resigned as general superintendent of the Springfield (Ill.) Light, Heat & Power Company, to become general manager of the Penn Public Service Company, with headquarters at Clearfield, Pa.

Mr. W. A. Everson has resigned his position as secretary, manager and contract agent of the Hamilton (Ohio) Gas & Electric Company to become associated with the Bonhoff & Joyce Company, having headquarters in Cincinnati.

Mr. Ralph D. Mershon has been appointed consulting engineer and inspector of machinery and materials for the Inawashiro Hydroelectric Power Company, Japan, which is building a generating plant of an initial capacity of 75,000 hp, the electrical energy to be transmitted 145 miles to Tokyo at 110,000 volts.

Dr. Friedrich Niethammer, professor of electrical engineering at the Technische Hochschule, Brünn, Austria, the well-known engineer and writer on electrical engineering subjects, is spending a month's vacation in this country visiting the points of interest in the eastern section of the United States and Canada.

Mr. Peter Junkersfeld, of the Commonwealth Edison Company, Chicago, delivered an address on March 29 before the students and faculty of the College of Engineering of the University of Illinois on "Engineering and Business Development." Mr. Junkersfeld is a graduate of the University of Illinois, class of 1895.

Mr. Irving H. Reynolds has returned to the engineering department of the Allis-Chalmers Company. Mr. Reynolds was for twenty years identified with that company and held the position of chief engineer. For the past few years he has been vice-president and general manager of the William Todd Company, of Youngstown, Ohio.

Mr. Thomas Edward Fox has resigned as superintendent for the Housatonic Power Company at Greenwich, Conn., to become associated with the Greenwich Engineering Company, in which he has acquired an interest. His successor will be Mr. G. F. Atwater, a graduate of the Sheffield Scientific School at Yale University.

Mr. E. E. Shumway, president of the Rocky Mountain Fuel Company, delivered an address on April 4 before the Colorado Electric Club on "Electrical Appliances in Coal Mining," in which he presented many interesting facts with regard to labor saving and installation and maintenance costs, as compared with steam installations, with coal at 50 cents per ton at the mine surface.

Mr. Dana Pierce, who has had charge of the electrical department of the Underwriters' Laboratories at Chicago for the past six years, has been appointed electrical engineer and agent of the Underwriters' Laboratories in charge of the New York office at 135 William Street. Mr. Pierce graduated from Amherst College in 1888 and pursued studies at Harvard, Cornell and Johns Hopkins.

Mr. Elmer P. Morris, vice-president of the Morris Iron Company, has established his headquarters at the office of the company at 90 West Street, New York, where he will take charge of the sales department for domestic and foreign business. For over a year Mr. Morris has superintended the construction and equipment of the plant at Frederick, Md. Mr. Oscar B. Coblentz will hereafter look after the manufacturing end of the business.

Prof. Theodore W. Richards, of Harvard University, has had awarded him the Willard Gibbs gold medal of the Chicago section of the American Chemical Society. This medal is awarded every year in recognition of some notable scientific work in chemistry. It will be presented to the recipient at a meeting to be held in the Hotel Sherman, Chicago, on the evening of May 17. At that time Professor Richards will give an address on "Atomic Weights."

Mr. Y. Ishikawa, electrical engineer of the Kyoto Electric Light Company, Kyoto, Japan, is on a visit to this country, where he will remain for about two months. During his stay Mr. Ishikawa will visit New York, Schenectady, Niagara Falls, Pittsburgh and Washington. He will then sail for Europe, touring England, Germany, Switzerland, Italy, France, etc., until October, passing thence via the Siberian Railroad across the continent to Manchuria and Japan, thus circling the globe.

Mr. J. Tachihara, consulting engineer for the Inawashiro Hydroelectric Company of Japan, sailed April 10 on the S.S. *Caronia* for England. As noted in these columns March 9, Mr. Tachihara visited this country for the purpose of noting developments in hydroelectric installations and while here inspected all of the notable plants. While abroad he will visit England, Germany, Norway and Sweden, and he will return to the United States via England in June on his homeward journey.

Mr. Edward K. Price has been appointed advertising manager of the Standard Underground Cable Company, Pittsburgh, Pa. Mr. Price was for a number of years in the publicity department of the Westinghouse Electric & Manufacturing Company, but for the past two years has been engaged in agency work with Mr. G. P. Blackiston. Mr. Price is an electrical engineer by profession, which, together with his advertising experience, makes him especially well fitted for his new work.

Mr. A. S. Duncan and **Mr. A. Podmore,** members of the engineering staff of the National Telephone Company of Great Britain, who were transferred to the Post Office Department when the National company was taken over by the government, have been appointed assistant electrician and assistant engineer respectively to the Constantinople Telephone Company (Société Anonyme Ottomane des Téléphones de Constantinople) and will shortly proceed to Constantinople to take up their duties.

Mr. Gleeson Murphy, vice-president of the General Motor Truck Company, has returned to Detroit from a trip to New York, Philadelphia and Boston, where he delivered a series of talks to the sales organizations at the various branches and ascertained the conditions for spring business. Mr. Murphy is favorably impressed with the general situation, having found the motor-truck market very active, especially in Boston, where the business compares well with New York and Philadelphia.

Mr. C. W. Scott, who has for the past four or five years handled the switchboard-appliance department of the general offices of the Westinghouse Electric & Manufacturing Company, at East Pittsburgh, Pa., has accepted a position as district sales manager of the Economy Fuse & Manufacturing Company, having charge of the sales in the New York territory, with offices at 106 Fulton Street, New York. Mr. Scott's extensive experience in the appliance field will prove of great value to the company in his present position.

Prof. James E. Denton, who recently retired from strenuous activities as an engineer and member of the faculty of Stevens Institute of Technology, with which he had been long associated, was the recipient of a token of esteem in the form of a watch and fob accompanied by an engraved testimonial containing the signatures of a majority of the alumni and professors of the institute. Professor Denton, who graduated from Stevens Institute in 1875, was the first alumnus to receive the degree of doctor of engineering from that school.

Mr. Paul Doty, vice-president and general manager of the St. Paul (Minn.) Gas Light Company, which controls the Edison Light & Power Company and the St. Paul Light, Heat & Power Company, will receive the sincere sympathy of his friends on the occasion of the death on March 31 of his wife, a daughter of General I. N. Stiles, of Chicago. Mrs. Dotty, who was for a time associated

with Miss Jane Addams at Hull House, Chicago, had always taken an active interest in welfare work, both public and private, and in civic improvement work.

Mr. Charles Norman Fay, formerly prominent in public utility administration in Chicago, has written a book, entitled "Big Business and Government," in which he advances, in an interesting manner, his ideas of the comparatively recent development of "big business" as deduced from his own experience. A Harvard graduate, Mr. Fay entered the banking business in Michigan as a young man, but in 1879 he went to Chicago and became general manager of the Bell Telephone Company of Illinois. About two years later, when the Chicago Telephone Company was organized, Mr. Fay was made vice-president and general manager of the new company, and he continued in this position until about 1888, when he resigned to become president of the Chicago Gas Trust. In the year 1886, or thereabouts, Mr. Fay organized the Chicago Arc Light & Power Company, which combined a number of small block-lighting plants in the central business district of Chicago. This enterprise was afterward merged with the predecessor of the present Commonwealth Edison Company. Mr. Fay resigned the presidency of this company at the same time he left the telephone business, and engaged in a manufacturing business in New York.

Mr. William Carroll, a faithful public servant, retired as city electrician of Chicago on March 19, his resignation to Mayor Harrison, presented when the latter took office over a year ago, having been accepted finally. Mr. Carroll has been connected with the Department of Electricity of the city of Chicago and its predecessor, the Bureau of Fire-alarm Telegraph, for thirty-eight years. He was a practical man, self-taught in electrical matters, and he began work in 1874 as a lineman, his first occupation being to dig a post-hole. Thereafter he was made successively battery man, repairer, assistant operator in the fire-alarm department, operator, superintendent of construction for the Department of Electricity when that was formed, and in May, 1905, he was appointed city electrician by Mayor Dunne. He was reappointed by Mayor Busse, although the latter was of opposite political faith from Mayor Dunne. Mayor Harrison took office a year ago and received the resignation of Mr. Carroll, with those of all the other heads of departments of the city government. A year elapsed before the present Mayor concluded to appoint a younger man and a technical graduate to the position, in the person of Mr. Ray Palmer. Mr. Carroll, who was born in Piqua, Ohio, in 1851, is a modest, unassuming man, but his wide practical experience in the electrical work of the city, with which his life has been identified, made his services valuable. He enjoyed the esteem both of the city officials and the electrical public in Chicago. He was city electrician nearly seven years, and his conduct of an important department through varying administrations was never assailed by the breath of scandal. During his connection with the fire-alarm bureau and the Department of Electricity Mr. Carroll has seen the service grow from the nucleus of the present fire-alarm and police-telephone bureaus to an important department of the city government having control of street lighting and all the electrical affairs of the city, with about 400 employees, and spending about $1,300,000 a year. Mr. Carroll was very popular with the men under him, and the employees of the inspection bureau and the force of lamp trimmers and repairers took occasion to express their regard, after Mr. Carroll's retirement from office, by presenting him with substantial tokens of their friendship. Mr. Carroll is a widower and has no children. Retiring at sixty-one with the modest savings of a lifetime, he intends to enjoy the rest to which the evening of a well-spent life is entitled.

WILLIAM CARROLL.

Dr. Rudolph Diesel, inventor of the Diesel internal-combustion engine, arrived in New York on April 6 for a visit of about a month. Dr. Diesel, who owes his title to the Institute of Technology of Munich, received a very flattering reception at a meeting in London on March 15 of the British Institution of Mechanical Engineers. According to one of our London contemporaries, gangways, gallery and platform were packed to their utmost limit, and a paper read by the distinguished inventor was followed with the deepest interest, and gave occasion for a very complimentary discussion. In the discussion a prominent engineer expressed the opinion that the double-acting, two-stroke cycle Diesel engine will monopolize the marine field, and another engineer prophesied that it would certainly supplant the high-speed vertical steam engine. Referring to the use of coal-tar as a fuel, one of the speakers mentioned a 100-hp Diesel engine which has been running satisfactorily for a year on ordinary coke-oven tar. Dr. Diesel, in some remarks following the discussion of his paper, stated that Lord Kelvin had been one of the first to recognize the importance of his engine, and after a thorough study had advised a British firm to undertake its manufacture. The London paper will be presented in this country by Dr. Diesel at St. Louis on April 13, at Chicago on April 18 and before the American Society of Mechanical Engineers in New York on April 30. Dr. Diesel is a director of the Busch-Sulzer Brothers-Diesel Engine Company, of St. Louis, which firm has the exclusive American rights to his patents.

RUDOLPH DIESEL.

Obituary

Mr. Edward H. Anderson, designing engineer of the railway department of the General Electric Company, died on March 30 at Schenectady, N. Y. Mr. Anderson was born March 17, 1868, on his father's cotton plantation in South Carolina, and graduated with honors from the electrical engineering course at the University of South Carolina. He entered the testing department at Schenectady in 1895, and in a few years was made designing engineer in the railway department, which position he held until his death. In this position he designed and developed apparatus for some of the largest railway systems in this country. He obtained a number of important patents relating to improvements in generators, railway motors, controllers, electric brakes and electric power transmission apparatus. He was also known for his electric automobile controller, which is now being used as a standard appliance. For a time Mr. Anderson applied himself closely to improving the design of railway apparatus, and the railway motors in general use to-day bear evidence of the importance of his work. Not only did he possess a mind capable of grasping every detail of the design and theory of electrical apparatus but he was singularly gifted with the power of being able to explain electrical problems in such a manner that they could be easily appreciated and understood by non-technical railway men and officials. Because of this faculty he was ever in demand by railway engineers and commercial representatives. Especially noteworthy is his scientific study of the railway motor with respect to its performance, power and energy consumption and heating under service conditions. In 1896 he married Miss Mary E. Anderson. Both he and his wife were well known in the social life of Schenectady, where Mr. Anderson was a member of the Mohawk Club and the Sigma Nu fraternity and an associate member of the A. I. E. E. The widow and two children, John C. and Francis B., and a number of Mr. Anderson's friends accompanied the body to Moore, Spartanburg County, S. C., for interment.

Construction

GADSDEN, ALA.—The Noccalula Ry., Lt. & Pwr. Co. is planning to build an electric railway from Gadsden to Noccalula Falls, a distance of 3½ miles. Louis Hart, Gadsden, is interested.

IRONDALE, ALA.—The American Radiator Co., Chicago, Ill., is reported to have purchased a site of 400 acres here for a foundry and, it is said, contemplates the construction of a hydroelectric power plant on the Cahaba River, 7 miles from the site, at a cost of between $1,000,000 and $2,000,000. W. H. Hill is president.

CASA GRANDE, ARIZ.—The Casa Grande Ice & Cold Storage Co. contemplates the construction of an electric plant to supply electricity for lamps and motors here. Fred Humphrey is president.

PHOENIX, ARIZ.—The Gila Pwr. Co. is planning to build a large storage reservoir at a horseshoe bend in the Gila Box Canyon. The company will construct a tunnel 1100 ft. long to divert the water to a generating plant which will be located at the lower end of the canyon.

WINKELMAN, ARIZ.—The Winkelman Wtr. Co. has made arrangements to secure electricity from the plant of the Ray Consol. Copper Co., in Hayden, to supply electricity for lamps and motors here and also for operating the pumping plant for irrigating the Winsor ranch. Norman H. Morrison is interested.

HAMBURG, ARK.—The City Council is contemplating issuing additional bonds to provide funds for improvements and extensions to the municipal electric-light plant and water-works system.

LITTLE ROCK, ARK.—The Arkansas Cold Storage Co. has applied to the City Council for a 30-year franchise to supply electricity in this city.

PINE BLUFF, ARK.—The Pine Bluff Co. is planning to enlarge its electric power house on West Fourth Street and will install additional machinery.

ALAMEDA, CAL.—Bids will soon be called for supplying the city of Alameda with electricity to operate the municipal plant.

ALTURAS, CAL.—Preparations are being made for tapping Cowhead Lake by a tunnel for the purpose of supplying water to operate an electric light and power plant and also to irrigate thousands of acres of land in the Surprise valley. The project involves an expenditure of about $500,000.

BAKERSFIELD, CAL.—The franchise to erect electric transmission lines on the roads and highways of Kern County was sold to the San Joaquin Lt. & Pwr. Co. for $2,000.

EUREKA, CAL.—The Hammon Eng. Co. has awarded a contract to the Western States Gas & El. Co., Eureka, to install an electric plant at the Jacoby Creek quarries. The contract calls for the installation of derricks and hoists and the erection of 4 miles of transmission line.

FRESNO, CAL.—Preliminary steps have been taken by the Park Commissioners for the installation of electric motors in Roeding Park to replace the gasoline engines now in use for pumping water for irrigating purposes. It is also proposed to use electricity for illuminating the park during the summer months.

GLENDALE, CAL.—The Board of Trustees has authorized the installation of an ornamental street-lighting system on Fourth Street, Grand Boulevard and Glendale Avenue. Ornamental lamp standards carrying five-lamp clusters will be erected. Service from the municipal electric-light plant will soon be extended to the newly annexed territory, for which $40,000 in bonds was recently voted.

GREENVILLE, CAL.—The Indian Valley Lt. & Pwr. Co. is preparing to extend its transmission lines from Greenville to Crescent Mills, Taylorsville and Indian Falls in the near future.

LAKEPORT, CAL.—Suits to obtain possession of the entire shore line of Clear Lake have been filed by the Yolo Wtr. & Pwr. Co. against the property owners. The company proposes to raise the lake 10 ft. above the low-water mark to supply water to irrigate 200,000 acres in Yolo County, and to generate electricity for lamps and motors.

LANCASTER, CAL.—The Southern Sierras Pwr. Co., which is erecting a transmission line from Inyo County to San Bernardino and vicinity, has agreed to erect a branch line from the main line to pierce the section of Antelope Valley lying east of the Southern Pacific tracks as soon as 25,000 acres are bonded for $1 per acre and agreements signed for the use of 2000 hp.

MODESTO, CAL.—The Yosemite Pwr. Co. has submitted a proposition to the Modesto and Turlock irrigation districts regarding the construction of joint reservoirs and the removal of the La Grange power plant above the proposed dam, so that the water used for generating power may be utilized for irrigation purposes.

PLACERVILLE, CAL.—The San Francisco-Oakland Terminal Pwr. Co. has purchased the property of the Sierra Water Supply Co. The water rights and property of the El Dorado Water and Deep Gravel Mining Co. are included in the deal.

REDLANDS, CAL.—The promoters of the proposed electric railway which will connect San Bernardino Valley with San Diego are planning to invade Yucaipa Valley with a branch line. Frank Helen and A. H. Koebig, Los Angeles, are interested.

ROSEVILLE, CAL.—Sealed bids will be received by J. H. Stinehan, clerk of Board of Trustees, until April 29 for furnishing materials and erecting a distributing plant for the city of Roseville.

SACRAMENTO, CAL.—The Board of Trustees has adopted an ordinance providing for the installation of electroliers by the property owners along J, K and L Streets and across thoroughfares from Alleys I and J to L, to be turned over to the city when installed. The ordinance also provides for the maintenance of the system by the city when completed.

SAN BERNARDINO, CAL.—Grading is being done for the trackless trolley line of the Lone Pine Utilities Co., which will operate from Swarthout Canyon region to Cajon Pass, connecting with the main lines of the Santa Fe and Salt Lake railroads at the latter place.

SAN FRANCISCO, CAL.—Sealed bids will be received by the Board of Public Works until April 24 for furnishing and installing substation equipment for the Geary Street municipal railway in accordance with plans and specifications on file with the board.

SAN FRANCISCO, CAL.—The Universal El. & Gas Co. has acquired a site on Brannan and First Streets, on which it will erect a large plant to furnish illumination in this and other cities around the bay. Claus A. and Rudolph Spreckels are interested in the company.

SAN FRANCISCO, CAL.—At an election held recently the proposition to purchase the property of the Bay Cities Telephone Co. to be owned and operated by the municipality was carried. Another election will be called to vote to authorize the city to issue $6,000,000 in bonds to pay for the system.

SAN JACINTO, CAL.—The Ramona Pwr. & Irrigation Co. is reported to have financed its project and will soon begin work on its large power plant in the San Jacinto Mountains.

SAN JACINTO, CAL.—The local electric-light plant owned by Roach & Chambers has been purchased by the Southern Sierra Pwr. Co. As soon as the transmission lines of the company are completed in the valley a 24-hour service will be established.

SANTA MONICA, CAL.—The promoters of an electric mono-railway system have applied for a franchise to operate a railway from tidewater to the Los Angeles city limits.

TULARE, CAL.—The Tulare Pwr. Co. is planning to extend its transmission lines into the Earlimart country and to erect a substation in the vicinity of Pixley.

WOODLAND, CAL.—Preparations are being made by the West Side El. Ry. Co. for the construction of a railway from Woodland to Red Bluff. The line will be extended south to Davis and through the Montezuma hills to connect with the Antioch railway at a point near Rio Vista.

BROOKFIELD CENTER, CONN.—A movement has been started to secure the extension of the electric-lighting service of the Danbury & Bethel Gas & El. Lt. Co. to Brookfield Center. The plan includes lighting the streets as well as residences and business houses.

COLLINSVILLE, CONN.—The Collinsville Co. is planning to build another dam and reservoir on the Farmington River, about a mile below its present works. A power plant will be erected to supply electricity to operate its mills.

HARTFORD, CONN.—At an election held recently the proposition to appropriate $25,000 for the installation of a new police signal system was carried; also the appropriation of $50,000 for the Gully Brook conduit and $50,000 for pumping station.

MERIDEN, CONN.—The Meriden El. Lt. Co. has awarded a contract for the erection of an addition to its power plant which will be utilized as a boiler house. Three new water-tube boilers will be installed.

WASHINGTON, D. C.—Plans are being prepared by Milburn, Heister & Co., Washington, D. C., for power house, etc., for the House of the Good Shepherd.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 11, for installing three electric passenger elevators, one in the naval hospital at Chelsea, Mass.; one in the naval hospital at Newport, R. I., and one in the naval hospital at Portsmouth, R. I. Plans and specifications may be obtained on application to the above bureau. H. R. Stanford is chief of bureau.

WASHINGTON, D. C.—A new lighting system similar to the one which has been installed around the White House, the Treasury and the State, War and Navy building will be erected on Seventh Street between Pennsylvania Avenue and New York Avenue. The merchants on Pennsylvania Avenue between Seventh Street and Washington Circle have petitioned the commissioners to install a new lighting system. The Electrical Department is planning to install new incandescent lamps on several streets of the city.

TAMPA, FLA.—Bids are being received by H. M. Stanford, manager of the Tampa Bay Hotel, for the installation of an electric-power plant at the hotel, to replace the old plant recently sold.

AMERICUS, GA.—The State Railroad Commission has granted the Americus Gas & El. Co. permission to issue $100,000 in capital stock and $350,000 in bonds under the following conditions: The company shall be allowed to issue $100,000 in stock and $275,000 in bonds to pay for the present property, the bonds to be sold at not less than 85. In addition an issue of $10,000 in bonds has been approved for working capital

and $15,000 in bonds for immediate improvements and extensions, making a total of $300,000. The company was also authorized to issue $50,000 in bonds for future improvements and extensions, subject to the approval of the commission.

MACON, GA.—The Central Georgia Transmission Co., a subsidiary of the Central Georgia Pwr. Co., has applied to the State Railroad Commission for approval of a proposed stock and bond issue of $4,500,000, the proceeds to be used for the erection of tower transmission lines from Macon and Griffin into Atlanta in the vicinity of Lakewood Heights and the erection of power stations to supply electricity in Atlanta.

BOISE, IDAHO.—The Great Shoshone & Twin Falls Wtr. Pwr. Co., Twin Falls, is planning to erect a transmission line from Mountain Home to Boise, a distance of 50 miles.

IDAHO FALLS, IDAHO.—The Idaho Falls El. Ry. has secured right-of-way and will soon begin work on construction of its proposed electric railway between Idaho Falls, Lincoln, Ammon, Iona and Heise, a distance of 40 miles. H. S. Sewell, Idaho Falls, is secretary.

CHICAGO, ILL.—The directors of the Chicago Tel. Co. have authorized the early sale of $15,000,000 in bonds, for extensions and improvements to its system.

CHICAGO, ILL.—Sealed proposals will be received by the Commissioners of Lincoln Park until April 17 for furnishing and erecting water-tube boilers, inclosing brick work, induced-draft apparatus, breeching and chain grate stokers for the proposed central heating plant located in the power house at Lincoln Park, according to plans and specifications prepared by Perkins, Fellows & Hamilton, architects, and Pierce, Richardson & Neiler, consulting engineers, Room 1409, Manhattan Building, Chicago. Plans and specifications may be obtained at the office of the consulting engineers, where bids will also be received.

EAST MOLINE, ILL.—Preparations are being made by the Tri-City Ry. & Lt. Co. for improvements and extensions to its system in East Moline, which will involve an expenditure of about $100,000 and include laying of double tracks on Third Avenue from First Street to Seventh Street and on Seventh Street from Third Avenue to First Avenue, installation of a large motor-generator set to furnish power for street-car line and extension of its railway system to the factory district north of the railroad tracks.

FORT SHERIDAN, ILL.—Bids will be received at the office of J. R. McAndrews, constructing quartermaster, until May 3, for furnishing and installing a pressure filter plant, pumps, motors and a hot-air-heating system in the pumping station at Fort Sheridan. A deposit of $10 will be required for plans and specifications, which will be refunded upon return of same.

HILLSBORO, ILL.—The proposition to grant the Hillsboro El. Ry. Co. a franchise to build and operate an electric railway to Taylor Springs, a suburb, has been appproved by the voters of the city. Work will soon begin on construction of road.

PERU, ILL.—The Citizens' Ltg. Co., La Salle, has been granted a 20-year franchise by the City Council to erect transmission lines into this city for the purpose of supplying electricity to local industries.

SHELDON, ILL.—The local electric-light plant has been purchased by W. B. Harpole, Momence, Ill., who operates plants in Kentland and Morocco. Electricity for operating the system here will be transmitted from Kentland.

BRAZIL, IND.—The Brazil El. Co. has applied to the City Council for a 25-year franchise to install and operate a steam-heating plant.

COON RAPIDS, IA.—S. D. Henry, who was recently granted a new franchise, will enlarge his power plant, install new machinery and extend the transmission lines to Dedham.

LINEVILLE, IA.—Application has been made for a franchise to install an electric-light plant here by John L. Therme, of Chicago, Ill.

MARSHALLTOWN, IA.—An option has been taken on the plant and property of the Marshalltown Lt., Pwr. & Ry. Co. by William Dows, Isaac Smith, John Reed and R. S. Cook, of Cedar Rapids. If the plant is taken over, substantial improvements and extensions will be made to the system, which will involve an expenditure of about $200,000.

SWEA CITY, IA.—The city is considering the installation of a municipal electric-light plant.

VINTON, IA.—Bids will be received by W. E. Klingman, city clerk, Vinton, Ia., until April 19 for construction of power house, to be built around the present site, construction to consist of about 200 cu. yd. of reinforced concrete. City to furnish sand and concrete. Plans and specifications are on file at the office of the city clerk.

BALDWIN, KAN.—Improvements are contemplated to the municipal light and water plant, which will involve an expenditure of about $18,000. Worley & Black, Kansas City, Kan., consulting engineers, are in charge of the work.

JEFFERSONTOWN, KY.—Steps have been taken to have the Louisville Ltg. Co. extend its system to this suburb to furnish electricity for lighting the streets and residences here. The company, it is said, is willing to extend its service provided sufficient business is guaranteed.

SOMERSET, KY.—The United Water, Lt. & Trac. Co., controlling the water-works, street railway and electric-light systems, has been taken over by a syndicate of Louisville, New Albany and Chicago men. Martin J. Insull, of New Albany, Ind., president of the Louisville & Northern Ry. & Ltg. Co., has been chosen head of the Somerset company. Henry Klauber, Bernard Flexner and Robert G. Gordon, all of Louisville, and Samuel Insull, of Chicago, are interested in the deal.

WILLIAMSBURG, KY.—Surveys are being made by H. M. Byllesby & Co., Chicago, of Cumberland Falls, near Williamsburg, with a view of erecting a hydroelectric plant. If the plant is erected, electricity will be transmitted to Louisville.

NEW ORLEANS, LA.—Plans for enlarging the drainage-plant power station to furnish electricity for municipal lighting are being prepared by Superintendent George G. Earl of the Sewerage and Water Board. The central power station, which furnishes power for the drainage machines, forms the nucleus of the plan.

CENTERVILLE, MD.—Bonds to the amount of $20,000 have been voted to construct a municipal electric-light plant.

ELKTON, MD.—The Home Mfg., Lt. & Pwr. Co., recently incorporated, proposes to acquire a small plant already established. A new power house 39 ft. x 45 ft. will be erected, at a cost of about $3,000, which will be equipped with a gas-producer engine of 180 hp, costing $15,800; transformers will be installed and conduits built, to cost about $9,500. W. S. Evans, James F. Powers, Edward Deibert, Elmore Deibert and Sterling Evans are interested.

FROSTBURG, MD.—The installation of a municipal electric-light plant here is under consideration.

ENDFIELD, MASS.—Investigations are being made here by the Turners Falls Pwr. Co., Turners Falls, with a view of submitting estimates of the cost of lighting the town by electricity.

FITCHBURG, MASS.—Bids will be received by the Worcester County Commissioners, Court House, Worcester, Mass., until April 16 for furnishing and installing electric-light fixtures in the Fitchburg court house, Fitchburg.

FRANKLIN, MASS.—The Union El. Lt. Co. is extending its transmission lines to Sheldonville to supply electrical service there.

GREENFIELD, MASS.—The County Commissioners have approved plans and specifications filed by Chace & Harriman for the erection of a concrete dam and abutments on Deerfield River, near Bardwell's Ferry bridge.

LUDLOW, MASS.—Surveys are being made on the west branch of the Swift River between Pelham Dam and Pettengill Bridge for the Ludlow Mfg. Associates. George D. Green, agent for the associates, has purchased farms in the vicinity as far north as Pelham Hollow for the purpose of building a dam to furnish power to generate electricity for the company. It is understood that the plant will be located at Pettengill Bridge.

MILFORD, MASS.—The International Trolleymobile Co. has applied to the Selectmen for permission to operate electric automobile buses in Milford. The company asks permission to erect poles and wires along a number of streets.

ROCKLAND, MASS.—A special town meeting will soon be held to vote on the proposition to establish a municipal electric-light plant.

WESTFIELD, MASS.—The appropriation committee has recommended an appropriation of $13,000 to macadamize North Elm Street from the Textile Manufacturing Co.'s plant to the top of Clay Hill, which also includes the placing of the wires underground.

WEST SPRINGFIELD, MASS.—Plans are being prepared by Thomas L. Hisgen for a campaign in favor of building a municipal electric-light plant. The present distributing system is owned by the town.

MASON, MICH.—The proposition of whether the city shall retain the municipal electric-light plant or grant a franchise to the Commonwealth Pwr. Co. will be submitted to the voters at the spring election.

MONROE, MICH.—Sealed bids will be received until April 22 by John S. Knapp, secretary of the Board of Poor Commissioners and building committee, of Monroe County, for furnishing materials for electric-lighting system at the Monroe County Infirmary, in accordance with specifications, copies of which may be obtained from the secretary. Bids will also be received on the same date for installation of such materials at the county infirmary.

BIWABIK, MINN.—The Village Council is contemplating the installation of a new street-lighting system.

DULUTH, MINN.—The City Council has asked the Duluth Edison El. Co. to submit to the city its best price for its plant complete.

EVELETH, MINN.—The City Council has approved the contract with the Home El. & Htg. Co. for the erection of 48 ornamental lamp standards, carrying five lamps each.

LUVERNE, MINN.—The Council contemplates establishing a 24-hour electric service, which will require the installation of additional equipment to cost about $5,000.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Co. contemplates the construction of a new substation in Minneapolis, to cost about $10,000.

MORRIS, MINN.—M. B. Lord has been granted a franchise to build and operate an electric-light plant.

MORRIS, MINN.—The proposition to issue $30,000 in bonds for the establishment of a municipal electric-light plant will be submitted to a vote on April 30.

TWO HARBORS, MINN.—The Great Northern Pwr. Co., Duluth, has submitted a proposition to the City Council offering to supply electricity to operate the municipal electric-light system. The company asks for a ten-year contract and agrees to assume the cost of equipping the municipal plant with machinery needed to change the plant from steam to electricity.

HATTIESBURG, MISS.—Bids will be received by T. P. Scott, secretary of building committee, Mississippi Normal College, Hattiesburg, until April 22 for electric-light plant, steam-heating and power plant, electric wiring, plumbing and sewerage for the Mississippi Normal College, plans and specifications for which may be secured upon application to R. H. Hunt, architect, Chattanooga, Tenn.

CLARKSDALE, MO.—The installation of an electric-light plant here is under consideration and a franchise has been asked for.

MONTGOMERY, MO.—The local electric-light plant has been purchased by E. H. Alger, of Jonesburg, for about $14,000.

WEST PLAINS, MO.—The City Council has accepted the proposition of the Mammoth Spring El. Lt. & Pwr. Co., Mammoth Springs, Ark., to furnish electricity for lamps and motors here. An election will be held April 30 to submit the proposition to the voters. Edward Bellamy is general manager of the company.

GREAT FALLS, MONT.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 17 for an electric passenger elevator in the United States post office and court house at Great Falls, Mont., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

HARLOWTON, MONT.—Preparations are being made by the Chicago, Milwaukee & Puget Sound Ry. Co. to equip its railway from Harlowton to Deer Lodge, a distance of 125 miles, for electrical operation.

MISSOULA, MONT.—The Independent Tel. Co. is planning to extend its lines into the Orchard Homes district; also other extensions.

TOWNSEND, MONT.—The Butte El. & Pwr. Co. has purchased the local municipal electric plant and is making arrangements to extend the transmission line from its generating plant on the Madison River to Townsend. The local system will be rebuilt and a 24-hour service established. The municipal plant will be abandoned.

LINCOLN, NEB.—The Lincoln Tel. & Teleg. Co. is planning to erect a new telephone exchange building.

CHOCORUA, N. H.—The Chocorua Hotel Co. has commenced work on the dam which will furnish power to operate its new electric plant.

BURLINGTON, N. J.—The City Council has passed an ordinance providing for the installation of a municipal electric-light plant. An amendment to the measure defers the proposition until the courts decide the constitutionality of the law.

MILLVILLE, N. J.—The report submitted to the City Council by Prof. Temple, of the University of Pennsylvania, for the installation of a municipal electric-light plant estimates the cost of the system at $29,827, and the operating expenses at $5,009 per year. The plans provide for a distributing system and lamps, etc., and a street-lighting system consisting of 150 arc lamps and 70 tungsten lamps. It is proposed to purchase power to operate the system from the Millville Mfg. Co.

SILVER CITY, N. M.—The Silver City El. Pwr. Co. contemplates the installation of a large ice factory in connection with its electric-light and power plant in Silver City.

BROOKLYN, N. Y.—The Nassau El. Ry. Co. has applied for a franchise to construct and operate an electric railway along Atlantic Avenue from Fifth Avenue to Shepherd Avenue, Brooklyn.

BROOKLYN, N. Y.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 23 for furnishing at the Brooklyn navy yard a quantity of naval supplies as follows: Schedule 4423—boiler gaskets, Schedule 4432—electrical supplies. Application for proposals should designate the schedule desired by number. Blank proposals will be furnished on application to the navy pay office, New York, N. Y. T. J. Cowie is paymaster general.

HOMER, N. Y.—The village of Homer, which proposes to install a municipal electric-light plant, has applied to the Public Service Commission, Second District, for permission to engage in commercial lighting as well as street lighting. Electrical service is now supplied by the Cortland County Trac. Co.

LESTERSHIRE, N. Y.—The proposition to issue $9,500 for the construction of a conduit system on Main Street will be submitted to the voters on April 16.

OGDENSBURG, N. Y.—The Town Board has granted the petition of the village of Heuvelton for the establishment of an electric-light district. Bids will soon be asked for the franchise.

OSWEGO N. Y.—The D'Oiler Engineering Co., of Philadelphia, Pa., has awarded a sub-contract for the installation and connection of motors and electrical machinery on locks between Oswego and Baldwinsville to King Brothers, of this city.

PATCHOGUE, N. Y.—The Public Service Commission has authorized the Patchogue El. Lt. Co. to exercise franchises in the town of Southampton to furnish electricity in that town west of Speonk River.

RED HOOK, N. Y.—The Red Hook Lt. & Pwr. Co. has petitioned the Public Service Commission for permission to exercise the rights and privileges granted by franchises from the Town Boards of Milan and Pine Plains and to begin the erection of transmission lines for transmitting and distributing electricity for lamps, heat and motors in those towns.

ROCHESTER, N. Y.—The Gorsline estate, owner of the buildings occupied by the P. C. Ford Shoe Co., Rochester Folding Box Co. and the William Hoyt Co. and one other building occupied by a number of small industries is planning to install a 150-hp electric plant to supply electricity to its tenants. A modern steam-heating system will be placed in the buildings and preparations will be made for connection with steam in case of accident or break-down in the electrical service.

SODUS, N. Y.—The Sodus Gas & El. Lt. Co. is contemplating erecting an electric-light plant in Cohocton, which may also be used to supply smaller towns in that vicinity. It is expected that electricity will be utilized for street lighting in Cohocton as well as for residences and commercial purposes.

SYRACUSE, N. Y.—The Syracuse Ltg. Co. has applied to the Public Service Commission, Second District, for permission to issue $220,000 in bonds, the proceeds to be used for laying of trunk extensions to distributing system and for improvements at the stations.

UTICA, N. Y.—The Utica Gas & El. Co. will soon begin work on the erection of steel towers for its new transmission line between Trenton Falls and Rome.

YONKERS, N. Y.—Plans have been prepared by William M. Weisenberger, Jr., 55 Duane Street, New York, architect, for the construction of a transformer station for the Yonkers El. Ltg. & Pwr. Co., to cost about $20,000.

BRYSON, N. C.—A company is being organized under the name of the Union Development Co. for the purpose of building a power plant near Bryson City. The proposed plant will cost about $250,000. J. W. Adams, Chattanooga, Tenn., is interested.

SPENCER, N. C.—J. B. McCrary & Co., Atlanta, Ga., have submitted a proposition to the City Council for the installation of an electric-light plant in Spencer.

ALLIANCE, OHIO.—Arrangements have been completed for the construction of an electric railway from the city limits of Alliance to the city limits of Akron, a distance of 23 miles.

COLUMBUS, OHIO.—A special election will be held on May 21 to vote on four bond issues as follows: The civic center calls for $350,000; electric-light plant extension, $265,000; grade crossings, $700,000, and the Third Street Viaduct, $425,000.

MINGO, OHIO.—The Council is considering the question of purchasing the local water and light plant to be owned and operated by the municipality. The Riggs & Sherman Engineering Co. has been engaged by the Council to make an appraisal of the old plant and to prepare plans and estimates of cost of building a new system.

SALEM, OHIO.—Plans have been submitted to the Council for the new electric-lighting system by the Bailey Engineering Co., which provides for four circuits of about 196 lamps each. Two estimates were submitted, one providing for the use of the poles of the Bell and the Columbiana County Tel. Co., to cost about $19,500, and the other for the city to own its own poles, making the cost about $23,000. The equipment for the generating system includes two 150-hp non-condensing tandem compound engines, two 100-kva, 2200-volt, 60-cycle, three-phase direct-connected generators, one 100-kw, three-phase to two-phase transformer, necessary switchboards, etc., two 200-hp water-tube boilers, feed-water heater, boiler-feed pumps, etc., to cost about $25,000.

SPRINGFIELD, OHIO.—The contract for construction of the new power house for the St. Raphael Parish has been awarded to William Poole, of this city. The power house will be used as a central plant and will supply heat for all the buildings.

BARTLESVILLE, OKLA.—Negotiations have been practically completed whereby the property of the Bartlesville Lt. & Wtr. Co. will be taken over by George C. Priestly.

OKLAHOMA, OKLA.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 18 for an electric passenger elevator in the United States post office, Oklahoma City, in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

CANBY, ORE.—The Canby-Molalla Ry. Co. contemplates the construction of an electric railway from Canby through the southeastern section of Clackamas County.

EUGENE, ORE.—Investigations are being made by the Oregon Pwr. Co. with a view of extending its transmission lines out on the Santa Clara road to supply electricity for lamps and motors to farmers and residents in that section. The Oregon Pwr. Co. will supply power for operating the cars. If there is sufficient demand, the Oregon company will extend its line to Irving later on.

SALEM, ORE.—Surveys are being made for the proposed electric railway along the Willamette River from Salem to Portland, to be built by the Southern Pacific R. R. Co.

PANAMA.—Bids will be received at the office of the general purchasing agent, Isthmian Canal Commission, Washington, D. C., until May 6 for furnishing blasting caps, detonators, safety fuse, insulating tape and lead wire, for period ending June 30, 1916. Blanks and general in-

formation pertaining to this circular (No. 701) may be obtained at the above office or at the offices of the assistant agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.

BUTLER, PA.—The Butler County Lt. Co. has applied to the Borough Council for a franchise to supply electricity here for lamps and motors. Charles F. Hosford, Jr., is attorney for the company.

FREELAND, PA.—Plans and specifications are being prepared by the Scofield Engineering Co., Philadelphia, Pa., consulting engineers, for the erection of a substation for the Hazleton El. Lt. & Pwr. Co., Hazleton, to be erected at Freeland, Luzerne County, contracts for which will be awarded soon.

HARRISBURG, PA.—Papers have been filed with the State Department announcing the absorption by the Pennsylvania Public Service Co., which operates in Cambria and other counties, of the following electric and other companies: Philipsburg, South Philipsburg, Osceola, Decatur Township, Chester Hill, Lawrence, Bradford, Rush Township, Morris Township and Cooper power companies, the new steam company in Clearfield, Clearfield Gas Co., Central Pennsylvania Lt. & Pwr. Co., Indiana Provision Co., Grampian, Curwensville, Anderson Creek & Pike Township electric companies. The Pennsylvania company has also filed a notice of increase in capital stock from $16,000 to $1,500,000.

HAZLETON, PA.—The Harwood El. Pwr. Co. has engaged the Scoville Engineering Co. as consulting engineer in connection with the construction of its power-house extension at Harwood and reconstruction of the substation in Hazleton. Plans are now being prepared and contracts will soon be awarded.

JOHNSTOWN, PA.—Several of the Main Street merchants, it is stated, are contemplating the installation of a small electric plant, to cost about $4,000, to supply electricity to light their stores.

JOHNSTOWN, PA.—Negotiations have practically been completed whereby the Citizens' Lt., Ht. & Pwr. Co., Johnstown, secures control of the South Fork El. Lt., Ht. & Pwr. Co., South Fork, and the Croyle Township El. Lt. Co.

McKEE'S ROCKS, PA.—Separate and sealed proposals will be received at the office of John P. Pastre, borough secretary, until April 15, for lighting the streets and highways of the borough with either electricity or gas, or both, for terms of one, three, five and eight years.

NEW CASTLE, PA.—Sealed proposals will be received at the office of the city clerk until May 13 for lighting the streets and highways of the city of New Castle with electric arc and tungsten lamps for a period of one, three or five years. The specifications call for 360 or more arc lamps and an indeterminate number of incandescent lamps. F. M. Hartman is city clerk.

PITTSBURGH, PA.—The Pennsylvania Lt., Ht. & Pwr. Co., of the North Side, is planning to enlarge its plant, which will include increasing the boiler capacity and the installation of stokers for the entire battery of boilers.

PITTSBURGH, PA.—An appropriation of $81,000 has been made by the Central District & Printing Telegraph Co. for improvements to the local plant. A new central office is to be erected in Sharpsburg, new equipment will be installed in the Mount Lebanon exchange and 9 miles of overhead wire will be displaced.

PITTSBURGH, PA.—Proposals will be received at the office of the secretary of Board of Education, Pittsburgh, until April 16 for furnishing supplies for a term of 14 months, ending July 1, 1913, including electric incandescent lamps, lubricating oils, rubber hose, garbage cans, etc. Specifications and details may be obtained on application to the superintendent of supplies, 725 Fulton Building, Pittsburgh, Pa. G. W. Gerwig is secretary.

ROYERSFORD, PA.—The Town Council has awarded the contract for street-lighting to the Philadelphia Suburban Gas & El. Co.

SOUTH BETHLEHEM, PA.—The plant and holdings of the Halycon El. Lt., Ht. & Pwr. Co. have been taken over by the Bethlehem El. Lt. Co.

PROVIDENCE, R. I.—The Narragansett El. Ltg. Co. has refused to accept the terms offered for the proposed franchise submitted by the special committee on lighting franchise of the City Council.

PROVIDENCE, R. I.—The Narragansett El. Ltg. Co. has purchased a controlling interest in the Narragansett Pier El. Lt. & Pwr. Co., Narragansett Pier, and also in the Wickford Lt. & Wtr. Co., Wickford. Arrangements have been made whereby the Narragansett company will supply the Rhode Island Co. with electricity for a period of 20 years to operate the Sea View railroad and the Narragansett Pier railroad, which extends between Narragansett Pier and Kingston. The Narragansett company will equip the road for electrical operation. The Rhode Island Co. will discontinue its power station at Hamilton and the Narragansett company will extend its transmission lines from its present terminus at East Greenwich to Hamilton and erect a substation there.

BARNWELL, S. C.—The proposition to issue bonds for the installation of a municipal electric-light plant will be submitted to the voters on May 8. J. B. McCrary & Co., Atlanta, Ga., are consulting engineers.

MITCHELL, S. D.—The City Council is considering the installation of a new street-lighting system. Both arc and cluster lamps are under consideration.

CHATTANOOGA, TENN.—Plans are being considered by O. M. West, secretary of the Department of Public Utilities, Grounds and Buildings, for lighting Jackson Park. It is proposed to install a conduit and erect ornamental posts. It has not yet been decided whether to use arc lamps or five-lamp clusters.

KNOXVILLE, TENN.—The Knoxville El. Co. contemplates extending its transmission lines to Pleasantville to furnish electrical service there.

SHELBYVILLE, TENN.—The Duck River Pwr. Co. contemplates the construction of three hydroelectric plants and a steam plant. The water-power is partially developed, and it is proposed to remodel dam and install two new waterwheels during the low-water period; also to build new penstocks and develop 300 hp under 10-ft. head. The grist-mill building on site will be used as a power house. Electricity generated at the plant will be transmitted to Shelbyville, Wartrace and Manchester, Tenn. The cost of the work is estimated at about $100,000. J. F. Boyd is president.

SPARTA, TENN.—Rights of way are being secured by the Anderson & Tubb Pwr. Co., of this city, for the erection of a transmission line from its power plant in Sparta to Cookeville and Monterey for the purpose of furnishing electrical service in those places.

ANSON, TEX.—The City Wtr. & Lt. Co. is planning to install a 160-hp electric plant, to cost about $10,000. J. W. Skinner is engineer in charge.

CORPUS CHRISTI, TEX.—Plans are being prepared for the construction of an electric railway from Corpus Christi southeast around the bay front to Ward's Island, a distance of 6 miles. Local capitalists are interested in the project.

DECATUR, TEX.—The municipal electric-light and power plant, recently destroyed by fire, will be replaced by a new plant at a cost of about $16,000. The equipment will include two generators.

DENISON, TEX.—The Texas Trac. Co. is making extensive improvements in the local street railway system.

DENTON, TEX.—Improvements and extensions are contemplated to the municipal electric plant which will treble the output of the power station. Improvements will also be made to the lighting system.

EAGLE LAKE, TEX.—The Eagle Lake Wtr. & Light Co. has taken over the water and electric systems owned by George Herder, Weimar, and formerly operated under lease by the Eagle Mfg. Co. The new company will install additional electrical equipment and extend the water mains. Mr. Herder is president of the company and G. E. Fussell vice-president and general manager.

PLAINVIEW, TEX.—The Malone Lt. & Ice Co. is planning to install a new engine and other machinery in its power plant.

SAN BENITO, TEX.—The San Benito & Rio Grande Valley Ry. Co. is preparing to begin construction of its interurban railway from Mission up the valley of the Rio Grande to the coal fields of Zapata County, a distance of about 125 miles. The city of Rio Grande has accepted the proposition of the company, under which it is to give a bonus of $25,000, free right-of-way through the town and terminal grounds. S. A. Robertson, San Benito, is president.

YOAKUM, TEX.—The City Council has granted J. W. Greer and associates a 50-year franchise to construct and operate a street railway on certain streets of the city and to install a gas-generating plant and distribution system. The plans of Mr. Greer and associates include the installation of a large hydroelectric plant on the Guadalupe River, about 12 miles from here.

SALT LAKE CITY, UTAH.—The Telluride Pwr. Co. will soon apply to the City Council for a franchise to supply electricity in this city.

PORTSMOUTH, VA.—The installation of a new lighting system is under consideration.

BEVERLY, WASH.—The Pacific Pwr. & Lt. Co., North Yakima, has been granted a franchise to supply electricity here for lamps and motors.

COLFAX, WASH.—A rural telephone company has been organized in Colfax with a capital stock of $100,000. Work will begin in the near future on the erection of telephone lines, involving an expenditure of about $50,000. The Farmers' Union and Grange is interested.

EVERETT, WASH.—The Puget Sound Trac. & Pwr. Co. has been awarded the contract for street lighting. The company is to furnish 231 arc lamps at $12,470 per year.

HILLYARD, WASH.—The Council has appointed a committee to investigate the cost of installing a municipal electric light and power plant.

HUSUM, WASH.—The Northwestern El. Co. has purchased a tract on both sides of the White Salmon River, about 3 miles from Husum, on which it proposes to erect a power plant, to cost approximately $1,000,000.

LYLE, WASH.—Plans are under way for the construction of an electric-light plant here. The proposed plant will be operated temporarily by steam until the large water-power near here is developed. Le Roy Park, D. E. Keasey and associates, of Portland, are interested.

PORT ANGELES, WASH.—The Navy Department has contracted with the Olympic Pwr. Co. to supply electricity for lamps and motors for the Puget Sound navy yard at Bremerton. The service will be supplied from the power plant on the Elwaha River, near here. The transmission line has been erected as far as Port Townsend. The company is also negotiating with the Bremerton-Charleston Lt. & Pwr. Co. for fur-

nishing electricity in Bremerton, Charleston and Manette. Thomas T. Aldwell is manager of the Olympic company.

SEATTLE, WASH.—Ralph R. Wheaton, Chico, Wash., is planning to install an isolated electric power plant to furnish service for private residence at Port Washington Bay, near Seattle.

FOND DU LAC, WIS.—The water commissioners will apply to the City Council for an appropriation of $30,000 for the purpose of installing an electric plant to supply electricity to operate the pumps at the various wells. New boilers, turbine engine and electric generating machinery will be required.

MADISON, WIS.—Separate proposals will be received by the Capitol Commission for furnishing material and labor for the interior finish of the great dome and central portion of the Wisconsin State Capitol, at Madison, as follows: Mason work, carpenter work, stone and marble work, plumbing work, electric work, heating and plumbing work and ornamental ironwork. Plans and specifications may be seen at the office of George B. Post & Sons, architects, 347 Fifth Avenue, New York, N. Y.; office of the Capitol Commission, Madison, Wis., and the Builders & Traders' Exchange, Milwaukee. Plans may be obtained by depositing $100 with Lew F. Porter, secretary of the commission, which will be refunded upon return of the plans.

WATERTOWN, WIS.—Bids will be received by William F. Voss, secretary of Water Commission, until April 22 for furnishing a 700 gal. low-lift centrifugal pump, one 10-hp induction motor and compensator. W. G. Kirchoffer, Madison, is engineer.

CHEYENNE, WYO.—The Greeley Pwr. Co., Greeley, Cal., has applied to the City Council for a franchise to furnish electricity here. The company offers to erect a transmission line from its power plant on the Cache La Poudre River to Cheyenne and supply electrical energy at the city limits at 1½ cents per kw-hr.

PENTICTON, B. C., CAN.—Tenders will be received at the office of F. H. Latimer, consulting engineer, Penticton, until April 18 for construction of concrete and steel power house, plans and specifications for which may be seen at the above office.

VANCOUVER, B. C., CAN.—The Canadian Pacific R. R. Co. has taken out a permit for the construction of combined power house and laundry, to be erected in the rear of Hotel Vancouver. The proposed plant will supply electricity for the Canadian Pacific R. R. hotel and to operate the machinery in the laundry.

VANCOUVER, B. C., CAN.—Plans have been prepared by the British Columbia El. Ry. Co. for the construction of a new substation on Earl's Road, South Vancouver. The building will be 70 ft. x 86 ft. with an additional half story at one end for transformer gallery. The equipment will consist of two 1000-kw motor-generator sets, two banks of transformers of 3000 kw each for light and power service, eight arc regulators with a total capacity of 8000 lamps and a switching station for a 10,000-volt feeder switch. The company has begun work on the construction of its extension on Vancouver Island from Victoria through Saanich peninsula to Deep Cove and of a branch to Union Bay, a distance of 23 miles.

VICTORIA, B. C., CAN.—Tenders have been authorized by the City Council for furnishing materials for the cluster-lamp system.

VICTORIA, B. C., CAN.—The auxiliary power plant of the British Columbia El. Ry. Co. will be enlarged and new equipment installed at a cost of about $25,000.

WINNIPEG, MAN., CAN.—Bids will be received by W. M. Houston until April 22 for materials and supplies for the year for the Manitoba government telephone system.

BERLIN, ONT., CAN.—The ratepayers on Queen Street North have petitioned for permission to install an ornamental lighting system. It is also proposed to erect ornamental lamps on King Street. All wires are to be placed underground.

BROCKVILLE, ONT., CAN.—The Council has decided to submit a by-law to the ratepayers on April 25 providing for the municipality to enter into a contract with the Hydro-Electric Commission for power for the municipal electric system.

KINGSTON, ONT., CAN.—The Hydro-Electric Power Commission has submitted a proposition to the city of Kingston for furnishing hydro-electric power as follows: For 3000 hp, $30.40; 4000 hp, $26.64, and 5000 hp, $24.25. If awarded a contract, the Hydro-Electric Commission will begin work at once on the erection of its transmission line. It is proposed to secure energy temporarily for Kingston, Brockville and Prescott from the plant of the New York & Ontario Pwr. Co., at Waddington, N. Y.

WALKERVILLE, ONT., CAN.—The Walkerville Lt. & Pwr. Co. is planning to extend its service into the township of Sandwich East. The company has applied for a 20-year franchise in the town and also for a contract for street-lighting.

GATINEAU POINT, QUE., CAN.—The town of Gatineau Point is planning to build a new municipal electric-light system, to cost $25,000.

NORTH BATTLEFORD, SASK., CAN.—Sealed tenders will be received by H. W. Dixon, secretary and treasurer, until April 30 for construction of power house, under Contract "B," plans and specifications for which may be seen at the town hall, North Battleford, and at the office of Chipman & Powers, engineers, Toronto, Ont., and Winnipeg, Man.

NORTH BATTLEFORD, SASK., CAN.—Tenders will be received by H. W. Dixon, secretary and treasurer, until May 15 as follows: Contract "H"—for furnishing and erecting boiler; Contract "J"—for furnishing and erecting 70-hp steam engine and accessories; Contract "K"—for furnishing and erecting a 500-kw generator and equipment. Plans and specifications may be seen after April 17, at the town hall, North Battleford, or at the office of Chipman & Powers, engineers, Toronto, Ont., and Winnipeg, Man.

GUADALAJARA, JALISCO, MEX.—The Chapala Hydro-Electric & Irrigation Co. is reported to have decided to extend its transmission lines to the Ameca mining district and the town of Ameca. Among the companies to be provided with electrical service by the new lines are: The Regina Mining Co., the Magistral-Ameco Copper Co., the Zapote group of mines and the Amoloya y Anexas Mining Co. Eugenio Pinzon is manager of the company.

MEXICO CITY, MEX.—Enrique Schoendube, Mexico City, has applied to the federal government for a concession to install a large hydroelectric plant on El Salitre River in Valle de Bravo. The petition asks for the right to use 5000 liters of water per second to generate electricity.

MEXICO CITY, MEX.—Ernesto F. Ayton and associates are planning to build a hydroelectric plant on the Guanacevi River, near Guanacevi, State of Durango, and erect transmission lines to the towns and mining camps in that section. Mr. Ayton has applied to the federal government for a concession for the project.

New Industrial Companies

THE CRAVENS COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 by George W. Cravens, Ralph Birchard and William N. Freudenreich. The company proposes to manufacture electrical devices.

THE GLOBE TELEPHONE COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $1,000,000 by C. W. McGonigle, J. B. Wheat and George W. Hemple. The company proposes to manufacture and deal in all kinds of telephone equipment.

THE LITTLE GIANT ELECTRIC CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture electrical and magnetic machinery, etc., by C. Swanson, Brooklyn; L. T. Noonan and A. D. B. Randolph, of New York.

THE MICHIGAN RAILWAY ENGINEERING COMPANY, of Kalamazoo, Mich., has been incorporated with a capital stock of $50,000. The company, it is understood, will be a subsidiary of the Michigan United Trac. Co. and will care for the construction and repair work of the traction company. The incorporators are: G. B. Dobbin, of Detroit; A. W. McLimont, of Kalamazoo, and S. W. Smith, of New York.

THE PACIFIC LAMP COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $100,000 by Christine Leslie, V. C. Griffin and others.

THE PARKS-ELECTRIC CYANIDE COMPANY, of Los Angeles, Cal., has been granted a charter with a capital stock of $10,000. The incorporators are: J. R. Parks, E. R. and J. A. Week.

THE PIERCE, WELLS & KEEDWELL COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $10,000 to manufacture motors, engines and machinery, etc. The incorporators are: Peter Kruider, the Bronx, and Albert Keedwell, 171 West Eightieth Street, New York.

THE RENO-KAETKER ELECTRIC COMPANY, of Cincinnati, Ohio, has been incorporated by Frank P. Colville, Henry Kaetker, Stanley Parvin and L. L. Knight. The company is capitalized at $15,000 and proposes to manufacture and deal in electrical machinery.

O. E. SHORT & COMPANY, INC., of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture motors, engines, machinery, etc., by G. P. Fall, E. J. Welch and H. L. Starr, all of New York.

THE STANDARD CARBON PRODUCTS COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $20,000 by C. L. Hollis, T. A. Johnson and L. T. Mayhew.

THE STANDARD ELECTRIC TOOL COMPANY, of Cincinnati, Ohio, has been incorporated with a capital stock of $10,000 to manufacture machine tools and electrical appliances by Frank H. Kunkel, Earl W. Griffin, Frank P. Hamilton, H. L. Aischolz and Marston Allen.

THE UNION ELECTRIC ENGINEERING COMPANY, of Chicago, Ill., has been granted a charter with a capital stock of $2,500 to manufacture electrical motors and machinery. The incorporators are: Ambrose A. Worsley, Walter P. Stuart and Hugo Krause.

New Incorporations

MALVERN, ARK.—The Hot Springs County Lt. & Wtr. Co. has been incorporated with a capital stock of $25,000 for the purpose of constructing and operating electric plants and erecting water-works systems for the purpose of supplying electricity, water and water-power to

towns in Hot Springs County. The officers are: John T. Gray, president; James Graham, vice-president, and T. B. Lee, secretary and treasurer.

SACRAMENTO, CAL.—The Natomas Wtr. Co. has been granted a charter with a capital stock of $5,000,000 for the purpose of developing power and irrigation systems. The incorporators are: Chauncey G. Goodrich, John T. Pigott and Hugh McCurdy, all of San Francisco.

SAN FRANCISCO, CAL.—The Mount Shasta Aqueduct Corporation has been chartered with a capital stock of $10,000,000 for the purpose of supplying water to cities, develop water-powers, etc. The directors are: Clarence E. Sheets, Oakland; Thomas H. Laine, of Berkeley; William L. Hawkins, Joseph P. Kennedy and H. McDonaugh, all of San Francisco.

SAN FRANCISCO, CAL.—The Coast Counties Gas & El. Co. has been incorporated with a capital stock of $4,000,000 for the purpose of doing a general gas and electric business in the Santa Cruz and Watsonville districts. The incorporators are: Henry Mallock, J. E. Daub, Oakland; William B. Bosley, S W. Pryer, George H. Susman, S. Volmer and K. I. Dazey, all of San Francisco.

SAN JOSE, CAL.—The Senonac Pwr. Co. of California has filed articles of incorporation with a capital stock of $500,000. The directors are: Charles A. Nones, C. P. Anderson, J. F. Tatham, A. L. Brassy and D. M. Burnett.

SESPE, CAL.—The Sespe Lt. & Pwr. Co. has been incorporated with a capital stock of $1,000,000 by Mason Bradfield, W. W. Hawkins, L. J. Patterson, N. A. Bailie and F. E. Flinn.

STEVINSON, CAL.—The Merquin Tel & El. Lt. Co. has been organized with a capital stock of $25,000 for the purpose of furnishing the Stevinson Colony with a telephone and electric-light service The officers are: A. L. Bruce, president; David Larson, secretary, and W. H. Joy, treasurer.

BOISE, IDAHO.—The Snake River Pwr. Co. has been incorporated with a capital stock of $900,000 by W. C. Pierce, J. A. Pinney and Willard White. The company proposes to supply electricity for lamps and motors in Boise and other cities.

ROCKFORD, ILL.—The Joslyn-Chandler El. Ltg. Co. has been granted a charter with a capital stock of $20,000 to operate an electric-light plant. The incorporators are: J. S. Joslyn, F. H. Chandler and E. D. Chandler.

SCOTTSBURG, IND.—The Indianapolis & Louisville El. Ry. Co. has been organized to take over the property of the Indianapolis & Louisville Trac. Co., which was sold March 21 at a receiver's sale. The company is capitalized at $1,200,000 and proposes to improve the service between Indianapolis and Louisville and contemplates an extension of the present line to Madison and eventually to Cincinnati. Jerome Hill, Jr., Pittsburgh, Pa., is president and J. E. Greeley, Louisville, Ky., vice-president.

BOONE, IA.—The Yadkin River R. R. Co. has been incorporated with a capital stock of $225,000 to build an electric railway from Boone to North Wilkesboro, a distance of 45 miles. The directors are: C. H. Cowles, Wilkesboro; W. J. Grandin, G. M. Grandin, Pennsylvania; J. T. Henderson, H. C. London, Lenoir, and T. B. Finley, North Wilkesboro.

RED OAK, IA.—The Home Ltg. Co. has been incorporated with a capital stock of $10,000 by H. E. Deemer, Thomas D. Murphy and William Cochrane.

BOONEVILLE, KY.—The Booneville Lt. & Pwr. Co. has been incorporated with a capital stock of $1,500 by H. C. Combs, T. C. Fuller and C. B. Moore.

BATON ROUGE, LA.—The Suburban El. Co. has been organized with a capital stock of $250,000 to take over the franchises asked for by local business men for a street-car line from the business district into North and South Baton Rouge. The incorporators are: S. J. Gianelloni, N. S. Dougherty, C. H. Dameron, Henry Y. Ronaldson, J. Allen Dougherty, L. U. Babin and others.

ADRIAN, MICH.—The Lenawee County Gas & El. Co. has been incorporated with a capital stock of $100,000 for the purpose of building, purchasing or leasing and operating electric and gas plants. The incorporators are: I. C. Eston, trustee; J. McCullom and George B. Fowler.

DULUTH, MINN.—Articles of incorporation have been filed for the Zenith Pwr. Co., of Duluth, with a capital stock of $50,000 by Oscar Mitchell, W. D. Bailey and F. M. Emanuelson.

LEWISTOWN, MONT.—The Spring Creek Pwr. Co. has been incorporated with a capital stock of $40,000 for the purpose of supplying electricity for lamps and motors. The directors are: L. H. Hamilton, J. W. Roberts, Great Falls; Samuel Phillips, D. F. Smith and B. E. Stack, of Lewistown.

SCHENECTADY, N. Y.—Articles of incorporation have been filed for the Tri-Town El. Co. with a capital stock of $10,000 by William A. Graves, Michael J. Hughes, Samuel M. Strong, A. T. G. Wemple and M. S. Lord. The company proposes to supply electricity in Glenville, Clifton Park and Ballston.

SYLVAN BEACH, N. Y.—The Sylvan Beach El. Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000 for the purpose of supplying electricity in Sylvan Beach and in the towns of Verona and Vienna. The directors are: Ira L. Snell, R. B. Downing and A. T. Garvin, of Oneida; Dr. Martin Cavana, Sylvan Beach, and Anna M. Hemstreet, Canastota.

Trade Publications

COMMUTATING-POLE MOTORS.—Bulletin No. 4940 of the General Electric Company illustrates and describes that company's latest development of the commutating-pole motor designated as Type DLC.

BRONZE AND BRASS RODS.—The Gilbert & Sons Brass Foundry Company, St. Louis, Mo., has issued Bulletin No. B-1, covering its complete line of phosphor bronze and brass in the form of bushings, round rods, hexagonal sticks and castings.

REFLECTORS.—In its Bulletin No. 11 the Opalux Company, 258 Broadway, New York, gives information on reflectors in general and on the type of reflector with depolished surface in particular. These reflectors are said to eliminate eye-strain when used with bowl-frosted lamps.

VEHICLE METERS.—A new booklet issued by the Sangamo Electric Company, Springfield, Ill., is devoted to a description of the ampere-hour meter as applied to pleasure and commercial vehicles. It will be of particular interest to central-station managers who are now encouraging the electric-vehicle business.

ELECTRICALLY OPERATED BRICK PLANTS.—Bulletin No. 4929 of the General Electric Company is devoted to the application of electric motors to the operation of brick plants. The bulletin contains a description of a representative electrically operated plant and contains data relative to the cost of operation.

ICE-MAKING FOR CENTRAL STATIONS.—Under the title "Ice-Making Profits for Central Stations," the Baker Ice Machine Company, of Omaha, Neb., has issued a booklet which gives much interesting information in relation to the possibilities of ice-making as a profitable adjunct of the electric-service business. This subject has been receiving much attention of late from electrical men, and as the booklet is sent free on request there should be a considerable demand for it.

OZONATORS.—In its Bulletin No. 4912 the General Electric Company gives a good outline of the properties of ozone and the action of ozone on air, and describes apparatus for producing ozone. The ozone is produced as the result of electrical discharges between numerous electrodes across which air is forced by a motor-driven blower. The power consumption is 70 watts for an alternating-current equipment and 87 watts for a direct-current equipment for delivering 4000 cu. ft. of ozonized air per hour.

STEAM SCALE AND DIAGRAM.—The De Laval Steam Turbine Company, Trenton, N. J., has issued a card on which is printed the Mollier, or heat-entropy, diagram and which is accompanied by a measuring scale devised for taking desired quantities off the diagram directly. By means of the scale one can read off at once the thermal units theoretically available by expanding steam adiabatically from one condition to another, the resulting velocity of the steam, the steam consumption in pounds per hour of a perfect engine and the duty in millions of foot-pounds per 1000 lb. of dry steam. Conversely, knowing the steam consumption or duty of an actual engine, the efficiency ratio can at once be determined, as also the quality of the exhaust steam. The chart covers both saturated steam and superheated steam and takes the place of a brief steam and entropy table in every respect except that specific volumes are not given. The pressures are given in pounds per square inch gage and inches of vacuum. This device should be of interest and service to every steam engineer.

LAMP EFFICIENCY.—A "Bulletin of Engineering Research" (No. 101), entitled "Lamp Efficiency," which has been issued by the engineering department of the National Electric Lamp Association, discusses the factors involved in the operation of incandescent lamps for a minimum cost of light. An analysis of the cost of light, factors controlling the cost of light (cost of energy and cost of lamp), the determination of the operating conditions under which a given type and size of lamp will produce light most economically and the approximate method of computing the best efficiency receive a detailed treatment. The subject is taken up in an analytical method and illustrated by a large number of curves showing lamp performance. This bulletin, the first number of a series of bulletins on engineering research which will be devoted to scientific discussion of various problems bearing upon the manufacture and use of incandescent lamps, will be of interest to the central-station man and, in fact, to any one interested in the economic production of light by means of incandescent lamps.

REFLECTORS.—The Holophane Company has published as a wall hanger a spacing chart that tells at a glance just which reflector should be used for the equipment of lamps of any given height and spacing in order to secure the most efficient and appropriate illumination. To determine the correct reflector to use under any conditions, it is necessary only to measure the distance between outlets and find the corresponding figure along the base of the chart. By following the perpendicular line at this point until the cross line representing the height above the floor at which it is desired to mount the lamp is reached, the heavy angle-line first encountered to the left of this intersection points out which type of reflector to use to obtain satisfactory results. The four types of reflectors represented provide for all conditions encountered in the average commercial installations, and it is these store and office systems that make up the bulk of the contractor's lighting work. This spacing chart reduces illuminating calculations to the simple process of putting the finger on the chart and following out the line.

Business Notes

THE CALIFORNIA GLASS INSULATOR COMPANY has commenced the operation of its plant at Long Beach, Cal. The site for the plant was secured from the Chamber of Commerce of that place. The office is at present located in Los Angeles.

THE EWBANK POWER TRANSMISSION & MOTOR COMPANY, which has developed a gasoline-electric motor truck for heavy haulage service, is planning to erect a factory for the manufacture of these trucks at Portland, Ore. The president of the company is Mr. S. M. Mears and the secretary Dr. H. B. Ewbank.

BRUCE PEEBLES & COMPANY, LTD.—Mr. John H. Bunting, of Bruce Peebles & Company, Ltd., Edinburgh, Scotland, will make a four months' tour in South America on behalf of his firm. He sailed from Southampton on April 12 for Rio de Janeiro, and in addition will also visit Buenos Aires. Valparaiso and other important cities.

ROBERT W. PAUL, maker of electrical instruments and scientific apparatus, maintains a New York office at 1 East Forty-second Street, as stated on page 605 of our issue for March 16, and not at No. 1 East Forty-first Street, as incorrectly printed on page 704 of our issue for March 30. The office is in charge of Mr. Cuthbert J. Brown

CARBO STEEL POST COMPANY.—The main office and factory of the Carbo Steel Post Company, successor to the American Steel Post Company of Los Angeles, Cal., have been moved from Los Angeles to Chicago Heights, Ill., this being due to the large increase and popular demand for Carbo steel posts and poles all over the United States.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 2, 1912.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,021,774. REGULATION OF ELECTRIC CIRCUITS; M. Guett, Hartford, Conn. App. filed July 9, 1910. A four-way indicating rotary snap switch.

1,021,857. OVERHEAD TROLLEY SWITCH; E. H. Anderson, Indianapolis, Ind. App. filed June 2, 1911. Flexible connections to prevent jar and jumping.

1,021,859. PRIMARY BATTERY; W. A. F. Bleeck, Brisbane, Queensland, Australia. App. filed June 25, 1909. Depolarizer consisting of chromic acid, hydrochloric acid and ferrous and nickel sulphates.

1,021,881. ELECTRIC INTERRUPTER DEVICE; C. H. North, Cleveland, Ohio. App. filed Nov. 16, 1908. Harmonic telephone signal.

1,021,900. STORAGE BATTERY; J. L. Smith, Detroit, Mich. App. filed Aug. 10, 1911. Has elastic non-conducting end-spacing frames.

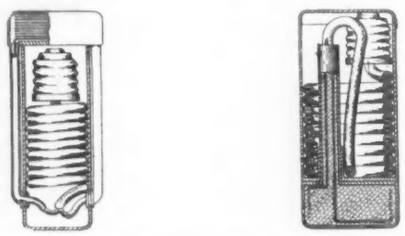
1,021,907. APPARATUS FOR PREVENTING SPARKING AT THE CONTACTS OF ELECTRICALLY ILLUMINATED SIGNS; R. F. Venner, Addiscombe, England. App. filed May 19, 1910. Quick break switch.

1,021,920. TELEPHONE RECEIVER; W. W. Dean, Elyria, Ohio. App. filed Oct. 8, 1908. Metal shell.

1,021,942. PRINTER FOR MULTIPLEX PRINTING-TELEGRAPH SYSTEMS; D. Murray, London, England. App. filed Oct. 1, 1909. Power-driven selecting and printing mechanism for operating a typewriter.

1,021,974. PORTABLE ELECTRIC HEATER; F. L. Dyer, Montclair, N. J. App. filed Oct. 7, 1910. A pocket device for heating a glass of water, etc.

1,021,989. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING IT; W. Morrison, Des Moines, Ia. App. filed Oct. 5, 1911. The active material is surrounded by a non-conducting porous envelope and wire gauze.



1,021,974—Portable Electric Heater.

1,021,990. BINDER FOR PEROXIDE ACTIVE MATERIAL AND PROCESS OF MAKING IT; W. Morrison, Des Moines, Ia. App. filed Feb. 20, 1912. An oxygen sulphur compound of lead tungsten.

1,021,991. BINDER FOR PEROXIDE ACTIVE MATERIAL AND PROCESS OF MAKING IT; W. Morrison, Des Moines, Ia. App. filed Feb. 23, 1912. Oxygen, sulphur, lead, tantalum and niobium.

1,021,992. BINDER FOR PEROXIDE ACTIVE MATERIAL AND PROCESS OF MAKING IT; W. Morrison, Des Moines, Ia. App. filed Feb. 23, 1912. Oxygen compound of niobium, sulphur and lead.

1,021,993. PROCESS OF BINDING THE ACTIVE MATERIAL OF POSITIVE-POLE LEAD ELECTRODES; W. Morrison, Des Moines, Ia. App. filed Feb. 23, 1912. A compound having tungsten in its acidic radical is dissolved in H_2O_2, then sulphuric acid added and the active material saturated.

1,021,994. PROCESS OF BINDING THE ACTIVE MATERIAL OF POSITIVE-POLE LEAD ELECTRODES; W. Morrison, Des Moines, Ia. App. filed Feb. 23, 1912. See patents above.

1,021,995. PROCESS OF BINDING THE ACTIVE MATERIAL OF POSITIVE-POLE LEAD ELECTRODES; W. Morrison, Des Moines, Ia. App. filed Feb. 24, 1912. The active material is electrolytically impregnated with a compound containing tantalum and niobium.

1,021,996. PROCESS OF BINDING THE ACTIVE MATERIAL OF POSITIVE-POLE LEAD ELECTRODES; W. Morrison, Des Moines, Ia. App. filed Feb. 24, 1912. The active material is impregnated electrolytically with niobium and then reacted on by sulphuric acid.

1,021,997. STORAGE-BATTERY CONDUCTOR OR SUPPORT; W. Morrison, Des Moines, Ia. App. filed Feb. 24, 1912. Lead, antimony and selenium or tellurium.

1,022,001. ELECTRICALLY CONTROLLED BRAKE; E. Price, Schenectady, N. Y. App. filed Oct. 16, 1908. For electric hoist.

1,022,009. ELECTRIC-ARC LAMP; E. Weintraub, Schenectady, N. Y. App. filed Nov. 17, 1904. Mercury-vapor type. The electrodes are initially separated for starting by heating the gas.

1,022,010. VAPOR ELECTRIC DEVICE; E. Weintraub, Lynn, Mass. App. filed July 13, 1909. A mercury electrode and a projecting copper block for dissipating heat.

1,022,011. REFRACTORY ARTICLE; G. Weintraub, Lynn, Mass. App. filed March 24, 1910. The material, such as magnesia, is formed in a mold and allowed to cool on a core to prevent fracturing.

1,022,016. ELECTRIC HEATER; W. S. Andrews, Schenectady, N. Y. App. filed Jan. 14, 1911. Sadiron with a thermostatic switch.

1,022,021. SPACE BLOCK; E. H. Farquhar, Schenectady, N. Y. App. filed Sept. 19, 1908. For separating the laminæ of armatures.

1,022,023. DYNAMO-ELECTRIC MACHINE; W. J. Foster, Schenectady, N. Y. App. filed Jan. 24, 1910. Ventilated rotor.

1,022,025. MACHINE FOR FORMING AND ELECTRICALLY WELDING TUBES; E. J. Guay, Lynn, Mass. App. filed Jan. 19, 1911. A strip is folded on a mandrel and joint welded by a wheel.

1,022,026. INSULATOR; J. A. Guthrie, Little Rock, Ark. App. filed July 24, 1911. Frusto-conical porcelain element in two parts.

1,022,029. MOTOR-CONTROL SYSTEM; K. F. Kingwell, Rugby, England. App. filed Jan. 4, 1910. For a pump system, etc.

1,022,049. ELECTRIC SWITCH; G. B. Reisbach, Milwaukee, Wis. App. filed July 25, 1910. Magnetic blow-out.

1,022,057. INCANDESCENT ELECTRIC LIGHTING; W. L. Bliss, Brooklyn, N. Y. App. filed Oct. 20, 1905. Turn-down lamp with polarized relay switch.

1,022,058. ELECTRICAL APPARATUS; W. L. Bliss, Brooklyn, N. Y. App. filed Nov. 1, 1906. Turn-down lamp with a three-wire conductor for distant control.

1,022,065. RINGER; W. W. Dean, Elyria, Ohio. App. filed July 11, 1910. Mechanical improvements for a telephone ringer.

1,022,121. INSULATOR PIN; C. J. Boyland, Indianapolis, Ind. App. filed Nov. 8, 1911. Rolled from sheet metal.

1,022,143. SUSPENSION DEVICE FOR TROLLEY WIRES; E. Kindler, Friedenau, Berlin, Germany. App. filed Aug. 9, 1911. An under-cut device for a wire of figure-eight cross-section.

1,022,144. TROLLEY; H. A. Krause, Philadelphia, Pa. App. filed Feb. 8, 1911. Current-carrying guard.

1,022,161. MEANS FOR FASTENING ELECTRIC CONDUCTORS TO INSULATORS; J. S. Thompson, Mill Valley, Cal. App. filed March 22, 1911. Bolt-operated clamping jaws.

1,022,175. TELEPHONE; R. A. Boniventure, New York, N. Y. App. filed March 29, 1911. Receiver support for a desk telephone.

1,022,189. REMOTE TEMPERATURE CONTROL; H. G. Geissinger, New York, N. Y. App. filed Sept. 24, 1910. Double temperature control for day and night conditions.

1,022,247. DISINFECTANT DEVICE FOR MOUTHPIECES; A. E. Le Ford, Boston, Mass. App. filed July 19, 1911. A disinfectant container and shield are secured to the mouthpiece.

1,022,253. TELEPHONE TRANSMITTER; M. Moloney, Christchurch, New Zealand. App. filed Oct. 25, 1909. Magnifying relay for long-distance work.

1,022,255. DYNAMO-ELECTRIC MACHINERY; C. A. Parsons and A. H. Law, Newcastle-upon-Tyne, England. App. filed July 9, 1909. Conductors are partially embedded in the iron.

1,022,276. PRIMARY BATTERY; Z. Szpor, Stanislawow, Austria-Hungary. App. filed Sept. 12, 1911. A soluble depolarizer of sulphate of copper.

1,022,310. PRESSURE GAGE; C. O. Everhart, Warren, Pa. App. filed July 3, 1911. High and low alarm.

1,022,324. CONTROLLING SYSTEM FOR MOTOR-TRACTION CARS; W. C. Mayo, El Paso, Tex. App. filed Feb. 24, 1908. Brake control and track sander.

1,022,329. FUSE; F. P. Poole and P. A. Brendel, Bridgeport, Conn. App. filed Dec. 15, 1909. Plug type.

1,022,350. TELEPHONE; C. C. Blackman, Bridgeport, Conn. App. filed May 4, 1911. Receiver and transmitter on a single bracket.

1,022,355. PROTECTING MEANS FOR ELECTRIC DISTRIBUTION SYSTEMS; G. A. Burnham, Saugus, Mass. App. filed Oct. 28, 1911. Each substation has an overload switch and a tripping magnet.

1,022,357. ELECTRIC TROLLEY; L. M. Davis, Portland, Ore. App. filed March 23, 1911. Automatic lubrication.

1,022,365. MECHANICAL METHOD OF TREATMENT OF FEED WATER TO BOILERS FOR PREVENTION OF INCRUSTATION, CORROSION OR PITTING; C. Haythorpe, Kennington, London, England. App. filed Nov. 25, 1911. Zinc and carbon elements.

1,022,374. TROLLEY WHEEL FOR ELECTRIC CARS; J. C. Eames, San Francisco, Cal. App. filed Dec. 2, 1909. Sheet-metal wheel with a separable grooved rim.